Victorian Wetland Condition Assessment

Energy, Environment and Climate Action

Cover image

Kings Billabong near Mildura / Latji Latji Country /
photo credit: Darryl Whitaker

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it.

We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

DEECA is committed to genuinely partnering with Victorian Traditional Owners and Victoria's Aboriginal community to progress their aspirations.

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1 Introduction

1.1 Context

The Victorian Wetland Condition Assessment (VWCA) was developed to provide a systematic measurement of wetland condition at a landscape scale for Victoria. It complements the Index of Stream Condition and Index of Estuary Condition to assess the environmental condition of Victoria's waterways.

The Index of Wetland Condition (IWC) remains a relevant tool for field-based assessments of the environmental condition of individual wetlands. As there are many thousands of wetlands in Victoria, it is not feasible to undertake a comprehensive state-wide assessment using the IWC.

The VWCA is a landscape scale approach based on remotely sensed information has meant wetlands across the state can be consistently assessed for the first time.

Similar to the ISC and IEC, the VWCA assesses wetland condition for the purposes of:

- Reporting on landscape-scale wetland condition to communities
- Providing an input to state policy, strategy and regional planning of wetland management
- Providing a benchmark for landscape-scale wetland environmental condition.

State-wide condition assessment programs provide broad information about the environmental condition of Victoria's waterways (DELWP 2016). The landscape scale VWCA is coarse in nature and is not suitable for assessing fine-scale trends in individual wetland condition. Consequently, the VWCA is not appropriate for the evaluation of management interventions or to provide detailed understanding of the complexities of how particular wetlands function or respond to threats.

The current approach is to rotate state-wide condition assessments among wetlands, estuaries and rivers with each waterway type assessed approximately every decade. This assessment frequency reflects that changes to the environmental condition of waterways are likely to be slow at this state-wide scale. However, at individual wetlands, there may be more rapid changes in response to new threats or management regimes. In the intervening periods between state-wide waterway condition assessments, management decisions will be informed by targeted, on-ground monitoring of key aquatic values and threats in specific wetlands.

1.2 What are wetlands and why are they important?

Wetlands are defined in the Victorian Waterway Management Strategy (VWMS, DEECA in prep.) as:

> "any area of land that is inundated with water – that may be standing or running, fresh or saline – with sufficient frequency and/or duration for the water to influence the plant and animal communities and ecological processes that occur there."

Wetlands occur in the interface between terrestrial and aquatic ecosystems and are highly variable spatially and temporally (Mitsch and Gosselink 2007). Although water is present for at least part of the time, the depth and duration of inundation is variable among wetlands and in individual wetlands over time. In Australia, the majority of natural wetlands would have been (prior to colonisation) intermittent, holding water for only part of the time. This, in turn, means that wetland biota needs to be adapted to these cycles of wetting and drying. Many species (e.g. waterbirds, frogs and fish) use wetlands during the wet phase and other habitats when wetlands are dry.

Globally, wetlands support a greater biodiversity than their area alone would suggest (Vörösmarty et al. 2010) and at least 24% of Victoria's threatened species are reliant on wetland habitat. The complex patterns of inundation create a large range of habitat mosaics that suit a broad number and diversity of biota including aquatic plants, fish, amphibians, waterbirds, invertebrates and reptiles. In Australia, many species have specific wetland water regime requirements for foraging, breeding and recruitment (Kingsford et al. 2016). For example, waterbird species often have specific water depth requirements for foraging based on their morphologies, with small waders needing wet mud or very shallow water, wading and dabbling species require shallow water (to 30 cm deep), while fish-eating (piscivorous) birds such as cormorants and pelicans require deep open water for foraging (Ma et al. 2010).

Intermittent wetlands are highly productive ecosystems, with a sharp rise in productivity when systems are initially inundated (Kingsford et al. 1999, Leigh et al. 2010, Bino et al. 2015). The arrival of water brings with it the activation of egg and seed banks and a mobilisation of nutrients from the sediment, this in turn leads to a boom in prey and other food sources for fish, amphibians, reptiles and waterbirds (Boulton and Brock 1999).

Wetlands provide many important ecosystem services (human-use benefits) and have been ranked as one of the most valuable ecosystems on the planet. Globally, wetlands cover just 1.1% of the biosphere but are estimated to supply more than a quarter of our ecosystem services (Costanza et al. 2014). The Directory of Important Wetlands in Australia (Environment Australia 2001) recognises many of Victoria's wetlands as nationally important. Some of the ecosystem services provided by wetlands include (Millennium Ecosystem Assessment Program 2005):

- Hydrological stability – flood control, groundwater replenishment
- Water purification – sediment and nutrient retention
- Climate change mitigation – carbon sequestration
- Biological control of pests – predators of agricultural pests (e.g. ibis feeding on grasshoppers / locusts)
- Wetland products – drinking water, food (e.g. fish), timber, livestock fodder
- Recreation – water sports, fishing, duck hunting, nature observation
- Cultural values – spiritually and culturally significant, sense of place, knowledge systems.

1.3 Threats to wetlands

The Millennium Ecosystem Assessment identified human population growth and associated increases in resource use as the major driver of global change (Millennium Ecosystem Assessment Program 2005). More recently, climate change has been predicted to be the second most important driver of global biodiversity change in the 21st century (second only to land use change associated with population growth) (Elmhagen et al. 2015). In many respects the impacts of climate change are exacerbating the stress that wetlands are already facing from land use change and water resource use.

Threats to wetlands associated with human population growth and water resource use include:

- Increasing intensity of land use in and immediately adjacent to wetlands, resulting in direct habitat removal and high levels of disturbance. This includes draining and infilling of wetlands for cropping (Text Box 1) and other agricultural activities and for urban development. Urban development may also generate excess stormwater, which can impact water and salinity regimes of surrounding wetlands.
- Increased pollutants (nutrients, sediments, toxicants) from agriculture, industry and urban areas.
- Water resource use either directly from wetlands, or more commonly from upstream catchments, diverting surface and groundwater from wetlands and altering water regimes.
- Increasing recreational pressure, with inappropriate activities such as vehicles in wetland beds, as well as disturbance of nesting, roosting and foraging birds.
- Increased invasive species as physical disturbance opens access for opportunistic and invasive species.

Credit: Sean Phillipson EGCMA

Threat of cropping to wetlands

Changes in land use can have significant impacts on wetland extent and condition. In several regions of Victoria, there have been significant land use changes in regional areas, particularly with a change from grazing to cropping. For example, in the Corangamite, Glenelg Hopkins and Wimmera regions there have been declines in pasture and increases in dryland cropping covering more than 300,000 hectares (White et al. 2020).

While grazing does have an impact on wetlands, there is evidence of recovery following removal of stock and reinstatement of hydrological regimes (Casanova and Casanova 2016). Repeated cropping of wetland areas, however, has a much higher impact on wetlands as it involves vegetation removal, mechanical disturbance and increased drainage. Cropping has the potential to permanently remove impacted sites from the landscape (Casanova and Casanova, 2016).

A spatial assessment undertaken in 2016 found that shallow, temporary freshwater wetlands were at higher risk of cropping than other wetland types and that the rate of impact had increased from 5% in 2010 to 45% in 2016 across the state of Victoria (Casanova and Casanova, 2016). Further analysis of wetlands in the East Grampians in 2020 indicated that 55% of wetlands are cropped to some extent, with the area of wetland bed subject to cropping covering around 24,000 hectares (Farrington et al. 2020). The authors found that cropping is higher in temporary systems, particularly temporary freshwater marshes and meadows which are most likely associated with the critically endangered Seasonally Herbaceous wetland community. The rate of increase of cropping between 2016 to present is lower than for the period from 2010 to 2016 but is still increasing (Farrington et al. 2020).

Text Box 1. Cropping in wetlands, left photo: example of cropping in the bed of an identified wetland (yellow outline), right photo: harvesting crops, photo credits DEECA.

We are living in a changed and changing climate and there is now a considerable body of evidence to suggest that south-eastern Victoria has become hotter and drier, particularly since the 1990s (Potter et al. 2010, Amirthanathan et al. 2023), with more frequent and intense climate hazards such as bushfires (VCSR24) . A reduction in rainfall, together with increased temperatures, solar radiation and evapotranspiration, together with increasing demands for water for consumptive use, results in reduced water availability for aquatic ecosystems. Altered water regimes, particularly a decline in the frequency and extent of inundation, are commonly observed in wetlands in south-east Australia (Adamson et al. 2009, Nielsen and Brock 2009, Sheldon et al. 2010, Gitay et al. 2011, Kingsford 2011).

Altered water regimes not only have an impact on biota that can be supported within a wetland but also have the potential to alter the physical and chemical properties of wetland systems. The reduction in freshwater inflows can result in an increasing concentration of salts in a reduced water volume, and in systems that have high salinity groundwater, a reduction in freshwater inflows can result in the movement of saline groundwater into freshwater wetlands (Nielsen and Brock 2009). In wetlands with potential acid sulphate soils, it is possible that reduced frequency of inundation and increased exposure of drying lake sediments could result in oxidization of the soils resulting in acidification of these sites.

1.4 Wetlands in Victoria

1.4.1 Victorian Wetland Inventory

The Victorian Wetland Inventory (VWI) is a comprehensive spatial dataset that catalogues the wetlands of Victoria. The VWI aims to maintain technical rigour around defining wetland ecosystems based on ecological and biophysical evidence to answer the question: 'Where are wetlands in the Victorian landscape'? The primary purposes of the VWI are to:

- support state waterway policy and strategy,
- support regional waterway management strategy, planning and investment, and
- fulfil Victoria's obligations under the Ramsar Convention.

The VWI has undergone several revisions and iterations, the most recent in 2025. The current VWI contains 427,540 mapped wetlands, covering an area of 1,101,368, hectares. This number includes artificial wetlands such as dams, reservoirs, sewage treatment ponds and saltworks. There are 61,779 mapped natural wetlands (5763951 hectares) across four natural aquatic ecosystem types:

- Lacustrine – non-tidal wetlands with less than 30% emergent vegetation cover (lakes)
- Palustrine – non-tidal wetlands with 30% or more emergent vegetation cover (swamps, marshes and meadows)
- Marine – subtidal and intertidal wetlands in embayments (e.g. Swan Bay, Lakes Victoria and King in the Gippsland Lakes)
- Estuarine – estuaries (tidal extent of rivers), coastal saltmarshes and semi-permanent supratidal wetlands adjoining estuaries.

Floodplains (land subject to inundation from river channels supporting water dependent vegetation communities that drains rapidly after inundation) are not included in the VWI.

The VWI contains not only a location map of each wetland, but a number of associated attributes, which are used to classify wetlands and assign a wetland type. Attributes of the VWI include salinity regime, water regime, dominant water source and dominant vegetation. There are 30 natural wetland types in the VWI:

- Estuarine – three types (coastal saltmarsh, mangrove, estuary)
- Marine – two types (intertidal flat and subtidal embayment)
- Lacustrine – four types (temporary saline lake, permanent saline lake, temporary freshwater lake, and permanent fresh lake)
- Palustrine – 21 types (based on water regime, salinity and dominant vegetation type)

1.4.2 Wetland Loss

In 1994, it was estimated that 26% of the area of Victoria's wetlands had been lost since colonisation. The loss was mainly due to drainage of wetlands and was much greater for freshwater (particularly freshwater meadows and marshes) than for saline wetlands (DEPI 2013). More recently, a study found that between 1988 to 2023 there was a potential 4% loss in the number of individual wetlands in Victoria, with these sites no longer experiencing inundation (John 2024). The findings highlight that wetland loss remains an ongoing issue in Victoria.

1.5 Management of wetlands

The VWMS provides policy direction for managing Victoria's wetlands and coordinates regulatory mechanisms to protect wetlands through a strategic management framework.

The Victorian Government invests in collaborations between waterway managers, landholders and other partners to support good wetland management practices and undertake on-ground management activities in priority management areas (as identified by regional waterway strategies). Traditional Owners have the right to partner with waterway managers to participate in or take a leadership role in developing and implementing regional waterway strategies with community, regional and statewide agencies and other stakeholders. This work is undertaken through voluntary agreements and cooperative partnerships.

The Department of Energy, Environment and Climate Action (DEECA) is primarily responsible for overseeing the Victorian Waterway Management Program (VWMP). The VWMP works alongside other programs and activities that contribute to outcomes for waterway values. Since 2013, the VWMP has focused on maintaining or improving environmental conditions, with waterway managers delivering successful regional programs in partnership with Traditional Owners, local government, environmental water holders, landholders and community groups. These programs include management of wetlands on public and private land, under the regulatory frameworks of the *Water Act* (1989), the *Planning and Environment Act* (1987) and the Victorian Planning Provisions (see Text box 11 for further information on management of wetlands on private land).

Outcomes of wetland management are assessed using management intervention monitoring programs (see Text Box 2).

Outcomes of wetland management

The key wetland management activities used in Victoria include restoring hydrological regime e.g., cease draining and extraction, reconnect with water sources), controlling invasive herbivores, revegetating with native species, reducing nutrient and pollutant input and fencing to exclude livestock access. These activities aim to counter vegetation degradation, soil and water quality impacts at wetlands so that they can better support wetland dependent species. The Wetland Intervention Monitoring Program (WIMP) has been developed by DEECA to assess the effectiveness of wetland management actions.

Phase 1 of WIMP examined the response of wetland vegetation under different grazing regimes. The program provides insights in determining optimal grazing strategies to protect wetland health and the factors that determine the most effective grazing regime for maintaining wetland values. Results show variable responses to grazing exclusion, influenced by factors like grazing pressure, weed presence, and wetland inundation duration.

Management intervention monitoring programs like WIMP are helping us to better understand how we can best manage Victoria's wetlands and protect these vital ecosystems. WIMP has yielded valuable information, but work remains to be done to determine optimal grazing strategies to protect or promote wetland condition.

Text Box 2. Outcomes of wetland management, left photo: scientist surveying wetland vegetation, right photo: A diversity of low growing herbs (left of fence) and dominance of Glyceria australis with high leaf litter (right of fence), photo credits: Arthur Rylah Institute - DEECA.

A quarter of Victorian wetlands are on public land, and they represent about 65% of wetland area. Public land managers, including Parks Victoria, catchment management authorities (CMAs), water corporations, local government and DEECA, are responsible for the management and protection of these wetlands. Australia is a signatory to the Ramsar Convention on wetlands, an international treaty for the conservation of wetlands through wise and sustainable use. Our responsibility under the Convention is to commit to halt the loss of wetlands and to maintain Ramsar-listed sites. Ramsar sites are Matters of National Environmental Significance under the *Environmental Protection of Biodiversity and Conservation Act* (EPBC Act). Actions that have the potential to impact the ecological character of a Ramsar site must be referred for formal environmental impact assessment as required under the *Victorian Environmental Effects Act 1978* (EE Act) and EPBC Act.

There are 12 Ramsar sites in Victoria (Figure 2). Ten of these were designated as Ramsar sites on the 15th of December 1982. Edithvale-Seaford Ramsar site was designated on 29th August 2001 and Glenelg Estuary and Discover Bay was designated on the 28th of February 2018.

In order to become a Ramsar site, wetlands must meet at least one of nine criteria related to unique, rare or representative wetland types, supporting nationally or internationally listed threatened species and communities, biodiversity, supporting critical lifecycles (e.g. breeding or migration) an abundance of waterbirds (collectively or of individual species), supporting significant native fish or an abundance of non-avian wetland species.

The portfolio of Ramsar sites in Victoria contain a broad range of wetland types, some of which are considered the best examples in the bioregion (e.g. Hattah-Kulkyne Lakes). They are significant for supporting a number of threatened species including the Australasian bittern (*Botaurus poiciloptilus*), regent parrot (*Polytelis anthopeplus monarchoides*), growling grass frog (*Litoria raniformis*), Murray cod (*Maccullochella peelii*), silver perch (*Bidyanus bidyanus*) and winged peppercress (*Lepidium monoplocoides*). Sites such as Kerang Lakes are significant for species during critical life stages (e.g. acting as drought refuges). Most Victorian Ramsar sites support breeding cycles of birds, fish and amphibians. Collectively Victorian Ramsar sites support 100,000s of waterbirds annually and more than 1% of the population of several species of waterbird including Australasian bittern, Australasian shoveler (*Anas rhynchotis*), Australian shelduck (*Tadorna tadornoides*), and chestnut teal (*Anas castanea*).


Credit: Sean Phillipson EGCMA

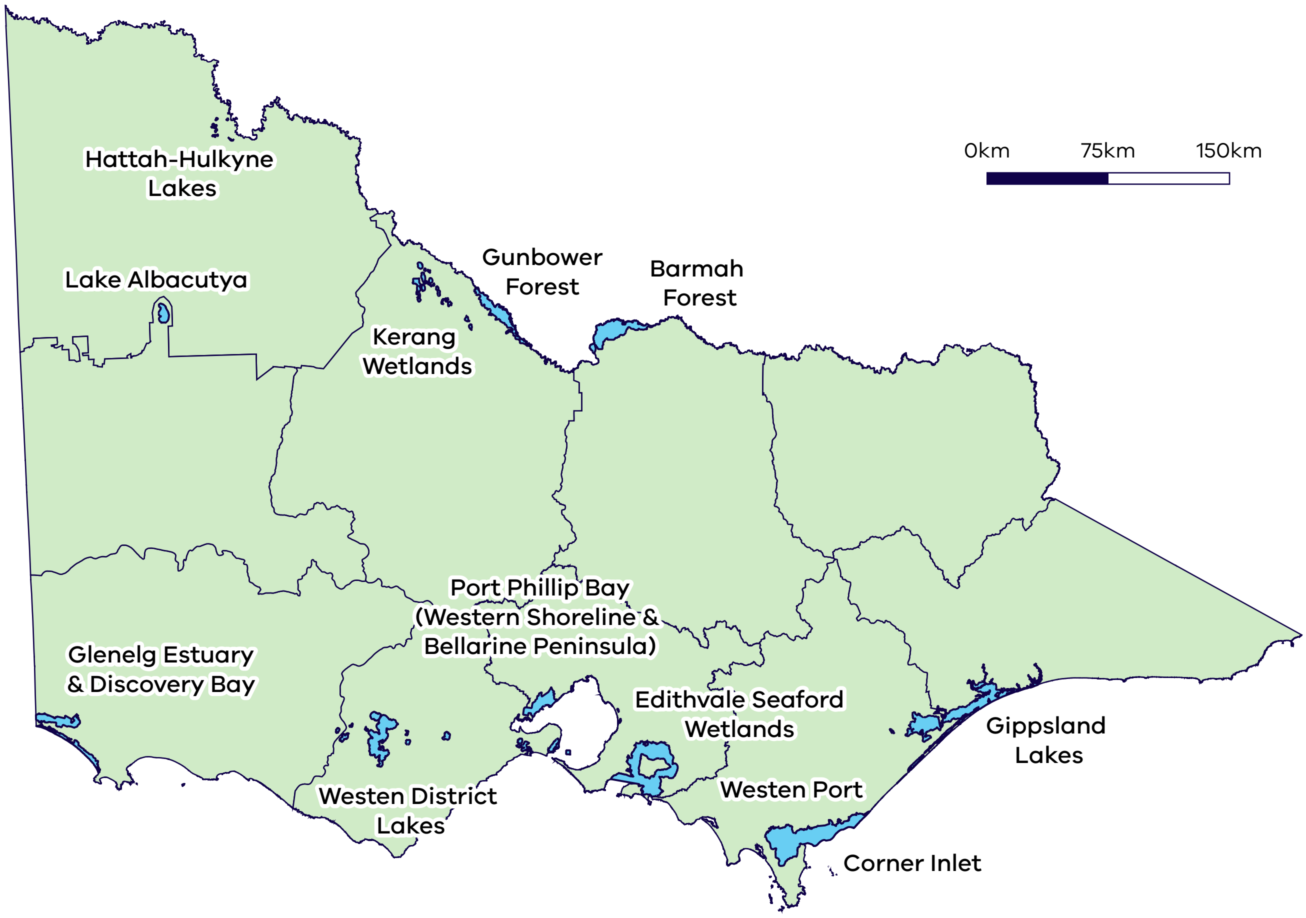


Figure 1. Victorian Ramsar sites.

1.6 Purpose and structure of the report

The purpose of this report is to document the methods and communicate the results of the first state-wide assessment of the condition of Victorian wetlands to the general public, natural resource managers, policymakers, and other interested readers.

The data products that underpin the Victorian Wetland Condition Assessment (VWCA) and the methods used to calculate condition scores are described in Chapter 2.

An overall summary of the condition of Wetlands across Victoria is provided in Chapter 3.

Following this, more specific information about wetland condition within different catchment regions is presented in Chapter 4.

2 Assessing wetland condition

State-wide assessments of waterway environmental condition have been periodically implemented in Victoria for rivers and estuaries. While all such assessments are challenging due to the scale of application, data limitations and the problem of establishing reference conditions, arguably a state-wide assessment of wetland condition is the most difficult. This is due to:

- the vast number of individual wetlands (the current VWI contains 62,223 mapped natural wetlands covering 577, 530 hectares)
- the immense heterogeneity of wetland types across the Victorian landscape (e.g. peatlands, permanent freshwater lakes, saltmarshes, temporary saline swamps, temporary river gum swamps, etc.)
- large variation in the size of Victorian wetlands (ranging < 1 ha – >10,000 ha)

Previously in Victoria, wetland environmental condition has been assessed at a relatively small number of wetlands using the field-based Index of Wetland Condition (IWC) (DSE 2012, Papas and Moloney 2012). This is consistent with national-scale assessments used globally, such as the United States Environmental Protection Agency's National Wetland Condition Assessment, which sampled 1138 wetlands across the continent to report on wetland condition (Herlihy et al. 2019). While these types of wetland-scale, field-based condition assessments yield valuable information, they are limited by the small number of wetlands able to be assessed and inability to use this data to infer condition in unsampled wetlands. The Victorian IWC cannot feasibly be implemented at a state-wide scale, so different assessment approaches are needed for this purpose.

Rapid improvements in spatial data availability have come from increasingly accessible satellite data and associated outputs. This has provided an opportunity to develop and apply a wetland condition assessment for Victoria that better captures the range of wetland types and conditions at the state-wide scale.

This Victorian Wetland Condition Assessment (VWCA) builds on the foundations of the theory and logic underpinning the IWC (DSE 2005, 2012), but accounts for recent advances in science and research to provide the best possible information for wetland planning and management at the state-wide scale. It draws heavily on several recent landscape scale wetland data sources developed through several initiatives including:

- Wetland Altered Water Regimes (John et al. 2023)
- Victorian Land Cover Series (White et al. 2020)
- Assessing Vulnerability for use in Determining Basin-scale Environmental Watering Priorities (Commonwealth of Australia 2023).

How outputs from each of these projects were used to assess condition of Victorian wetlands is described briefly in section 2.2. More detail on the spatial analysis and the methods that were used to develop each one of these data products can be found in the source documents referenced.

2.1.1 Defining wetland condition

The Victorian Waterway Management Strategy (DEPI 2013) acknowledges that threats will influence waterway condition and values. It is acknowledged that there is no universally accepted definition of environmental condition. However, for the most recent statewide environmental condition assessment; the Index of Estuary Condition (IEC) "condition" was defined as:

> measuring the extent to which environmental attributes that characterise an ecosystem in its desired state have been retained (or degraded).

This definition has been adopted for the Victorian Wetland Condition Assessment (VWCA) and is consistent with relevant Victorian policies and tools including Habitat Hectares (Parkes et al. 2003), the Index of Wetland Condition (DSE 2005) and the Index of Stream Condition (Ladson and White 1999). In this context, the 'desired state' may be characterised in several ways, including:

- supporting complex ecological structures and networks
- supporting maximum diversity of native species
- being free of invasive or exotic species
- having natural ecological, hydrological, and geomorphological processes that continue to operate effectively, including maintaining spatial and functional links with other systems and regions
- being relatively undisturbed by post-colonisation human activity.

2.2 Structure of the Victorian Wetland Condition Assessment

2.2.1 Selecting subindices, measures and metrics for the VWCA

The Victorian Wetland Condition Assessment (VWCA) draws on the theory and logic underpinning the Index of Wetland Condition (IWC). The IWC was developed by a panel of natural resource managers and scientists with expertise in wetland ecology, aquatic biota, water chemistry and geomorphology. The method development followed a rigorous process of peer review and testing to ensure that the conceptual framework that underpinned the method and selection of indicators was fit for purpose and scientifically defensible. Although the ultimate output was a site-based assessment method for wetland condition (DSE 2005, DELWP 2016), the underlying principles and framework are equally applicable at the landscape scale.

The IWC adopted an approach that uses a mixture of direct measures of wetland components, with measures of impact or threat. The assumption is made in the IWC that there is a negative correlation between the threats and impacts and condition. This is consistent with the approach adopted for the Index of Stream Condition (DEPI 2013) and Index of Estuary Condition (DELWP 2021a), which both have used direct measures of condition (e.g. cover of vegetation) as well as indirect measures of impact (e.g. altered hydrology).

There are six subindices and nine ecological components in the field based IWC. A review of available remotely sensed data and derived products indicated that there were suitable data to cover four sub-indices at the landscape scale (Table 1). Each of the sub-indices and how they were used to assess condition in the VWCA are described below.

Table 1. Indicators for the Victorian Wetland Condition Assessment.

IWC Sub-index	Ecological component	Landscape-scale data product	VWCA Metric(s)	Metric type
Wetland catchment	Wetland catchment	Victorian Land Cover Series	Intensity of land use in a 1 km area around each wetland	Threat
	Wetland buffer	None available		
Physical form	Area of the wetland	None available		
	Wetland form	None available		
Hydrology	Water regime	Altered water regimes	• Magnitude of inundation • Duration of inundation • Frequency of inundation • Dryness fraction	Threat
Water properties	Nutrients	None available		
	Salinity	None available		
Soils	Disturbance of soils	Wetland Insight Tool	Bare soil extent	Condition
Biota	Wetland plants	Wetland Insight Tool	Vegetation extent	Condition

2.2.2 Wetlands included in the state-wide assessment

The VWCA in Victoria has been applied to the recently updated VWI (see section 1.4). Consistent with the IWC, the VWCA has been limited to natural inland wetlands (lacustrine and palustrine). It does not apply to broad areas of floodplain vegetation (e.g. Gunbower Forest) but does include individual wetlands on the floodplain. Marine, estuarine and coastal systems, including coastal saltmarsh and mangroves are not included in the VWCA, nor are artificial wetlands, sewage treatment ponds or dams.

As the metrics for the VWCA are all derived from Landsat satellite imagery, which has a 30-metre pixel size, the assessment was limited to wetlands > 0.27 hectares (3 pixels). In addition, there are several very large (> 10,000 hectare) wetlands in Victoria. These wetlands comprised between 20% and 48% of the total wetland area in a Region / and or river basin (Table 2). These wetlands have not been included in the VWCA, because of the disproportionate influence their results would have on area weighted condition scores (see section 2.4.2).

The VWCA was applied to 32,456 natural inland wetlands in Victoria covering an area of 488,203 hectares.

Table 2. Inland, natural wetlands > 10,000 hectares in Victoria that were not included in the VWCA, and the proportion of total wetland area in their respective Regions and river basins.

Overall IEC Score	Area (ha)	Catchment region (% of total wetland area)	River Basin (% of total wetland area)
Lake Corangamite	24,680	Corangamite (31%)	Lake Corangamite (38%)
Lake Hindmarsh	13,879	Wimmera (23%)	Wimmera-Avon (20%)
Lake Tyrell	17,476	Mallee (29%)	Avoca (36%)
Lake Wellington	14,943	West Gippsland (37%)	Latrobe (48%)

2.2.3 Reference condition

Assessing condition requires a comparison of current states to some form of reference condition. An ecosystem that more closely resembles the specified reference is assumed to be in better environmental condition that one that deviates substantially from reference.

Many ecological assessment programs (e.g. IEC, ISC, field based-IWC) define the reference condition as the condition of an ecosystem prior to it being highly-modified by intensive degrading anthropogenic development of the immediate and/or surrounding landscape (e.g. condition of ecosystems before colonisation in the Australian context).

First Nations actively contributed to shaping the Victorian landscape through traditional management and cultural practices. First Nations peoples deliberately altered the landscape to suit them, and it was their fine-scale management that made Aboriginal-managed landscapes more diverse, productive and predictable than unmanaged landscapes (Cumpston et al. 2022). The pre-colonisation reference condition of an ecosystem can be modelled from a variety of sources, mostly from areas excluded from those intensive degrading practices, including data from minimally-modified systems within national parks or reserves, historical data, modelling, expert opinion or a combination of two or more of these (Hawkins et al. 2010).

Different approaches to characterising benchmarks or reference conditions have been used for the different sub-indices that comprise the VWCA. The land use sub index uses native vegetation and aquatic land cover classifications as reference condition, with more intensive or highly-modified land cover classifications representing greater deviation from healthy landscapes and therefore worse environmental condition (see section 2.2.4).

The Hydrology, Soils and Biota sub-indices are based on remote sensing data, which has been collected since the 1980s. While both measured and modelled benchmarks or reference conditions have been used, these are limited to the time period for which data has been collected. Therefore, these sub-indices assess wetland condition as a deviation from reference conditions derived using observations over the past ~40 years. Therefore, the VWCA is not an assessment of altered wetland condition from Aboriginal-managed landscapes or a pre-colonisation state.

For example, if the hydrology of a wetland had been highly impacted prior to 1988, and remained consistently impacted since that time, it would likely be assessed as being in excellent hydrological condition because there has been little departure from the variability captured during the period of the satellite record.

The Hydrology, Soils and Vegetation sub-indices of the VWCA assess departure from reference conditions derived from the satellite record (i.e. since the 1980s) rather than deviation from Aboriginal-managed landscapes or conditions prior to colonisation in the Australian context

2.2.4 Wetland catchment (land use) sub-index

A wetland's catchment (the area from which it receives water) is defined by its geomorphic setting. The type and intensity of land use within a wetland's catchment impact wetlands in several ways (Figure 2):

- the hydrological regime, including frequency, duration, extent and timing of inundation and the length of time between inundation events (e.g. due to levees, drains, roads, surface and / or groundwater extraction) (Kingsford 2000, Knox et al. 2022).
- the loads and forms of nutrients and sediments that enter a wetland (Young et al. 1996, Harris 2001, Ierodiaconou et al. 2005)
- the types and concentrations of toxicants (Mossop et al. 2013, Sardiña et al. 2019)
- biological connectivity for wetland flora and fauna (e.g. the ease with which propagules and fauna can move between aquatic systems and natural terrestrial environments) (Eppink et al. 2004, Houlahan et al. 2006)
- direct physical damage (e.g. vehicles, machinery, livestock entering a wetland ecosystem from adjacent land) (Casanova 2007, Morris and Reich 2013)
- increased pest plants and animals within wetlands.

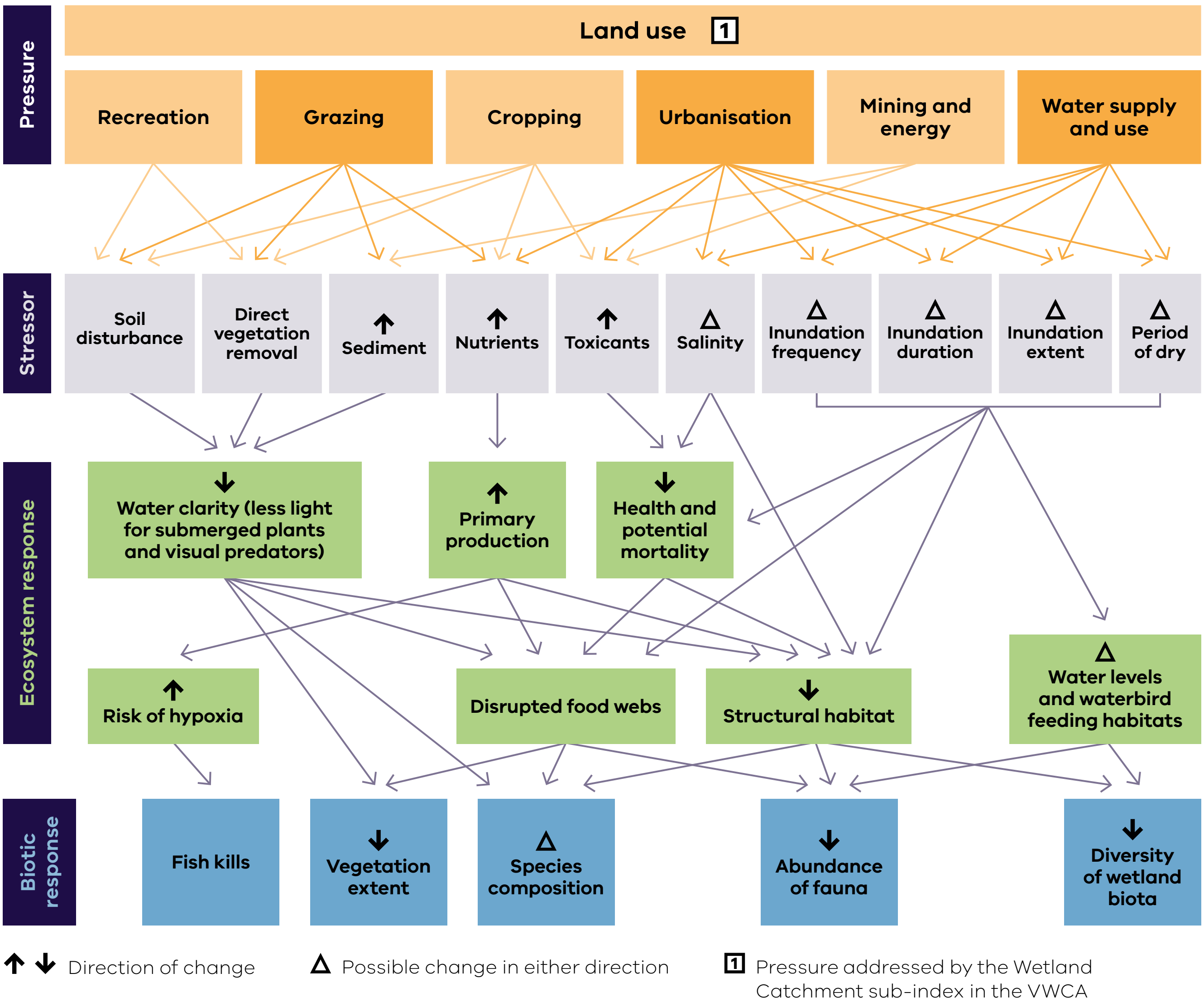


Figure 2. Conceptual diagram depicting the main pathways (arrows linking boxes) by which the threat (pressure) of land use can link to stressors and ecosystem and biotic responses. The numbered box indicates the pressure addressed by the Wetland Catchment sub-index in the VWCA. Arrows within boxes indicate the direction of change; Δ indicates a possible change in either direction.

Source data

The Victorian Land Cover Time Series provides a consistent through time, whole-of-state, spatial land cover data set for 7 epochs (1987–1990, 1990–1995, 1995–2000, 2000–2005, 2005–2010, 2010–2015 and 2015–19). The dataset uses Landsat satellite imagery and local calibration (or training) data. The most likely layers (one for each epoch) classify each pixel in to one of 19 land cover classes (White et al. 2020). In order to assess condition for this sub-index of the VWCA, the most recent epoch was used (2015–2019) and the land cover classes were converted to the Land use intensity classes of the IWC (Table 3).

Table 3. Alignment of IWC land use intensity classes with the land cover time series classes.

Land use intensity class	IWC land use	Corresponding Land Cover class
Very high	Built urban (including alpine resort development), industrial, intensive animal production, multiple-lane roads, multiple-track railway, aqueduct, water storage	Urban area, built environment
High	Cleared land for urban development, irrigated agriculture (cropping, horticulture and pasture), broad acre cropping, medium- or high-density grazing, golf course, playing field, major roads (not multiple lane), vehicle tracks in peatland wetlands	Disturbed ground, exotic pasture, dryland cropping, Horticulture/irrigated pasture and crop
Medium	Non-indigenous plantation forestry, low-density grazing, minor roads/tracks and railways	Conifer plantation, other exotic tree cover, native pasture
Low	Forestry in native forests, nature conservation with moderate to high recreational use	Hardwood plantation, scattered native trees, natural low cover
Very low	Nature conservation with low recreational use	Treed native vegetation, native shrubland, saltmarsh, mangroves, wetland perennial, wetland seasonal

Calculation of condition scores for wetland catchment.

As the name implies "wetland catchment" is a sub-index that is applied at the catchment rather than wetland scale. The field based IWC applies this within a 250m area around the wetland perimeter. This area is too small to be applied at the scale of Landsat imagery (30 metre pixels) and was expanded to 1 kilometre for the VWCA. The output was the percentage of each land use intensity class within one kilometre of each wetland assessed.

Wetland catchment was scored from 0 to 400, consistent with the method of the IWC as follows:

Land use intensity score = (% of very high intensity land use x 0) + (% of high intensity land use x 1) + (% of medium intensity land use x 2) +(% of low intensity land use x 3) + (% of very low intensity land use x 4).

The resulting scores were assigned to condition classes.

Land use intensity score	Condition score	Condition class
>335	5	Excellent
>265 - 335	4	Good
>200 - 265	3	Moderate
>135 - 200	2	Poor
0 - 135	1	Very poor

VWCA Wetland catchment subindex does not differentiate wetland buffers

The relatively coarse spatial resolution of Landsat imagery (30 metre pixels) means that fine scale heterogeneity in land cover cannot be measured with this approach. For this reason, an assessment of a finer scale area around wetlands (e.g. the IWC component "wetland buffer") cannot be done. Therefore, instances where a wetland is surrounded by high intensity land use but has the protection of a buffer of native vegetation may be assessed as being in poorer condition in the VWCA than would be the case using the IWC field-based method or finer resolution vegetation and habitat assessments (see Text Box 7).

2.2.5 Hydrology sub-index

Hydrology is a primary driver of wetland ecology and influences all aspects of the ecological condition of a wetland from wetland type to nutrient cycling and the types of biota that will be supported by the system. There are several aspects to wetland water regime that are important ecologically (Figure 4):

Depth – different waterbird foraging groups have specific water depth requirements, for example small waders require very shallow water or wet mud to forage, while aerial diving, fish eating species like cormorants require deeper water. Water depth is also a determinant of vegetation growth-form and size. Wetland plant species often occur along a gradient of water depth and duration of inundation and have been classified into functional groups according to their preferences and tolerances (Figure 3).

Duration of inundation – is important for plants and animals that require the presence of surface water to complete reproductive cycles (i.e., to grow, flower, and set seed, or to nest and fledge). For example, growling grass frogs require extended durations of inundation, as they have a long larval stage (Clemann and Gillespie 2012) and Australian pelicans require over four months of inundation to successfully fledge chicks (Johnston 2016).

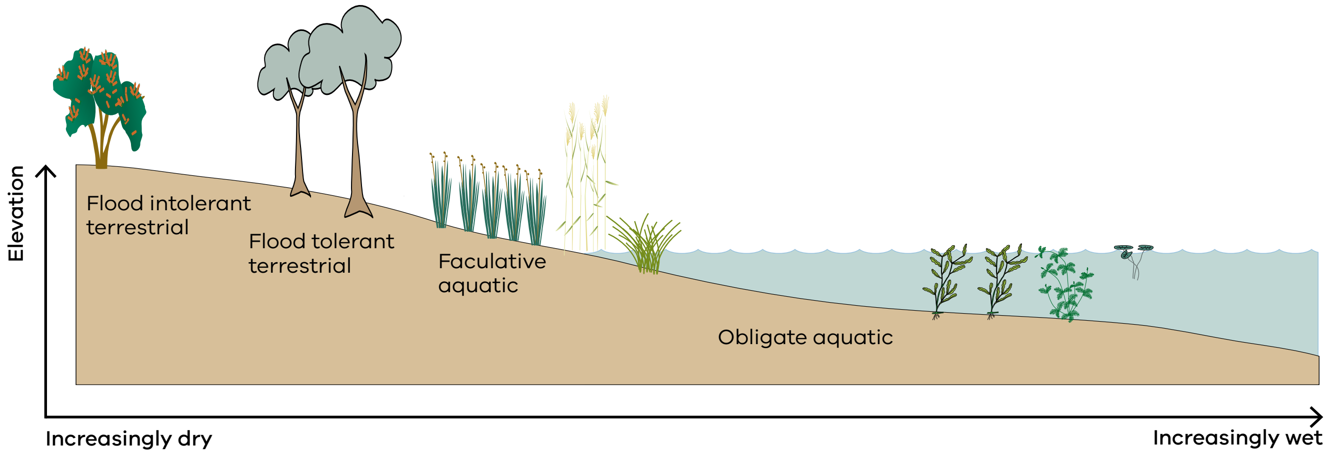


Figure 3: Effect of elevation and duration of inundation on the zonation of wetland plants (adapted from Brock and Casanova 1997).

Timing of inundation – is important mostly due to seasonal effects on temperature. Inundation in spring, as temperatures are warming, speeds physiological processes. Productivity is higher in warmer temperatures and some species of plants have germination temperature thresholds (Roberts and Marston 2011). Changes in the timing of inundation has proven to be determinantal to some wetland species for example, winter inundation is less favourable for frog species (Wassens et al. 2017). Whereas inundation continuing through summer months can lead to an increased risk of avian botulism and effects on waterbirds (Brandis et al. 2020). Summer inundation may alter the competitive interactions of species, for example, irrigation flows over summer in Barmah Forest caused giant rush (Juncus ingens) to invade Moira grass plains (Parks Victoria 2020).

Rate of rise or fall – rapidly rising water levels can drown out aquatic plants before they can grow to keep leaves or stems above the water line. Rapid rates of fall can prevent the completion of lifecycle stages such as storing of energy in underground vegetated states, fledging of waterbirds, metamorphosis of tadpoles to adult frogs, or movement of fish back into the river system.

Magnitude of inundation – is the extent of inundation within a wetland, but in many instances, also provides an indication of water depth. The greater the area inundated, the deeper water will be in the topographically lower portions of the wetland, and the more fringing and littoral vegetation is subject to periods of wet conditions. In addition, magnitude of inundation can influence flushing of some wetlands, with large inundation events required to ensure salts, nutrients and sediments do not continually accumulate.

Period of dry – many wetland biota and ecological processes are reliant on a dry phase. Several species of wetland plant require dry periods to survive (e.g. aeriation of soils for floodplain and riparian trees Roberts and Marston 2011) or to reproduce sexually. Extended periods of dry conditions can also cause impacts. For example, terrestrial species and weeds as well as native species such as giant rush can become invasive under prolonged dry conditions (Mayence et al. 2010). Prolonged periods of dry and disturbance of wetland sediments can lead to the acidic condition upon re-wetting when acid sulfate soils are present. Periods of drought have also proven to increase predation on waterbirds and chicks, in a drying landscape where other prey may become less abundant (Johnston 2016).

Altered hydrology can be mitigated through the use of environmental water (see Text Box 3).

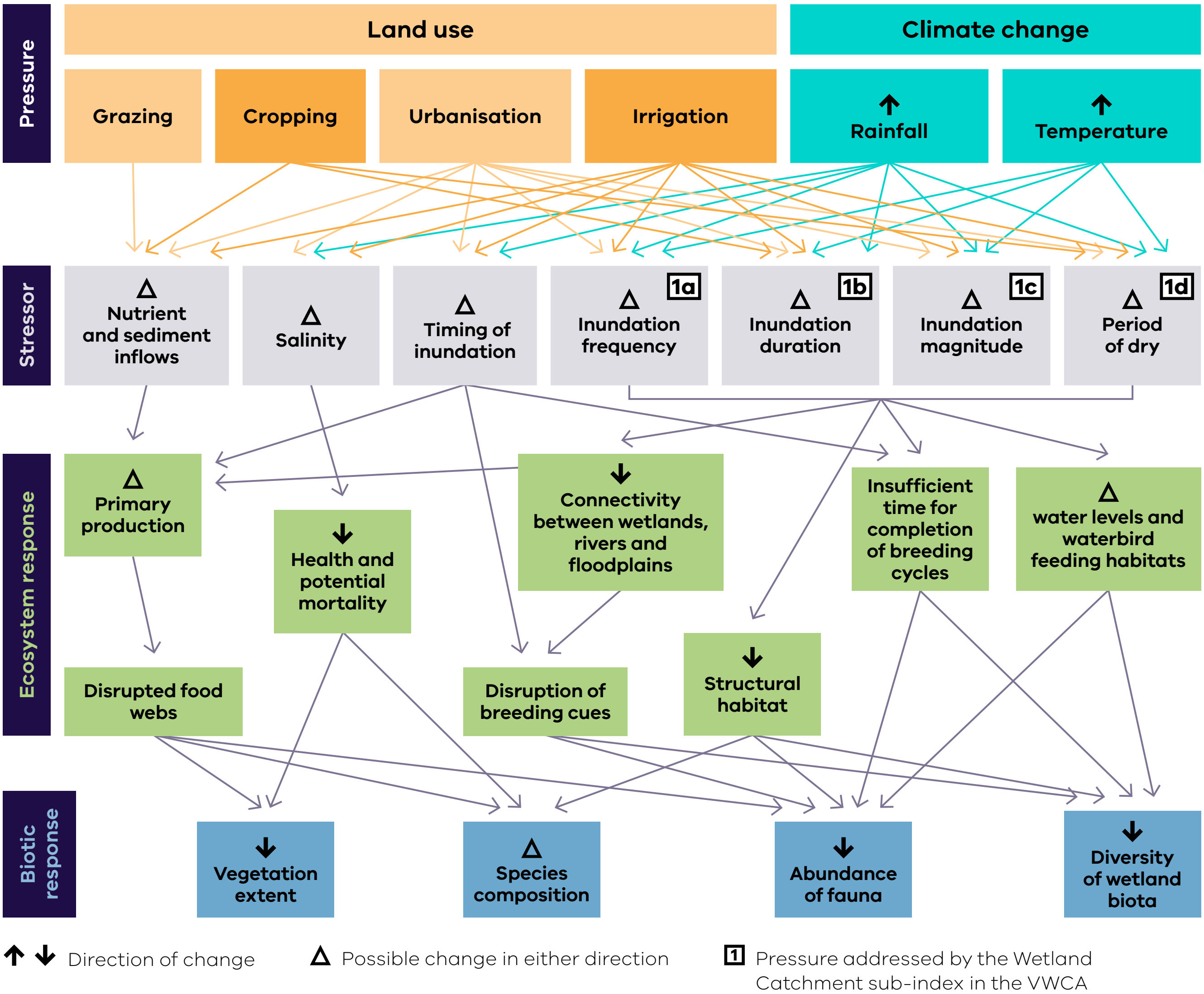


Figure 4. Conceptual diagram depicting the main pathways (arrows linking boxes) by which the threat (pressures) of land use and climate change can link to hydrological related stressors and ecosystem and biotic responses. The numbered box indicates the stressors addressed by the Hydrology sub-index in the VWCA. Arrows within boxes indicate the direction of change; Δ indicates a possible change in either direction.

Source data

The Wetlands Altered Water Regimes Project (John et al. 2023) developed a suite of quantitative hydrologic stress metrics and applied them to Victorian wetlands. These metrics were used to assess the change in wetland water regime across Victoria during the 1988–2022 period (see John et al. 2023). Four of these hydrological stress metrics were used in the VWCA (Table 4). The method was based on Geosciences Australia Wetlands Insight Tool (WIT) data that uses the Landsat record to identify inundation over time within wetland polygons (Dunn et al. 2019). Data from the period 1988 to 2022 were used in calculations for the metrics used in the VWCA.

The hydrology sub-index of the VWCA does not include a measure of wetland loss (see John (2024) and Text Box 6). It is acknowledged the hydrologic regime of many Victorian wetlands has been impacted, leading to the loss of some prior to 1988.

Table 4. The Hydrologic metrics used in the VWCA.

Metric	Rationale for inclusion	Calculation
A. Frequency	Describes how often inundation occurs. Important for ecological processes that occur over different timescales, such as breeding	Total number of times inundation exceeded a given extent
B. Duration	Describes how long inundation lasts. Important for wetting/drying cycles. Wetlands that are inundated for too long can suffer poor vegetation outcomes	Mean annual length of time (spell length) above a given inundation extent
C. Magnitude (mean)	Describes general wetland water availability. Important for total vegetation cover/extent	Mean annual inundation extent
D. Dry fraction	Describes for how much of the year the wetland is completely dry. Important for species adapted to periods of variability (i.e., drought adaptation traits) and ecosystem processes (i.e. nutrient cycling)	Proportion of the year with no water extent

Briefly, the stress metrics are derived using the following steps (described more fully in John et al. 2024):

1. For each hydrologic metric, an estimate of 'natural' variability is obtained by removing a linear trend from the 1988–2022 dataset (i.e. data are detrended)
2. The linear trend required to depart from 'natural' variability is estimated by the trend required such that the mean of the observed data at the end of the timeseries sits outside the 95th percentile range of sampling variability from the detrended data.
3. The observed trend in the data is calculated
4. The stress metric is then calculated as the ratio of the observed trend against the required trend to depart from existing variation, and the sign of the trend is used as the sign of the index (to distinguish between reductions or increases in metrics).

It is important to note that the hydrologic regime of many Victorian wetlands have been impacted long before 1988. While the term 'natural' variability has been used in the description of step 1 above, this does not refer to a completely naturalised wetland state (e.g. prior to colonistion), rather a contemporary baseline reflecting a stationary regime at the level of impacts experienced around the start of the observation record in 1988 (John et al. 2024).

A calculated stress metric <-1 or >1 suggest the wetland is experiencing a substantially different hydrologic regime across the period analysed (i.e. 1988–2022). This approach is illustrated in Figure 5 using example data. The stress metrics have the following benefits:

- Take advantage of the whole observation record (no need to divide record into samples)
- Can be corrected for autocorrelation to facilitate statistical inference
- Can be combined with bootstrap significance testing
- Will generally become more robust with longer records.

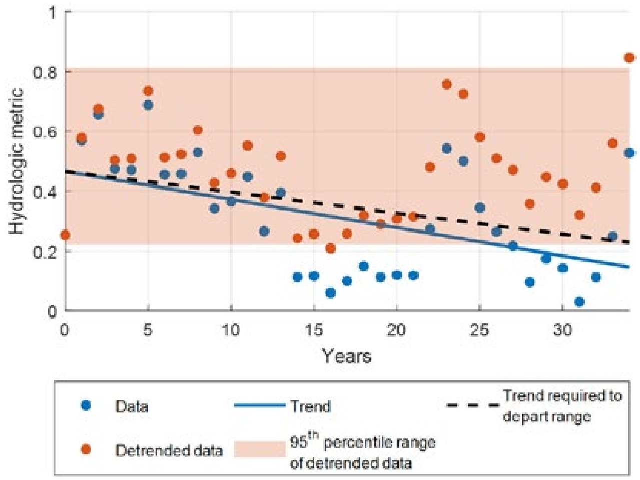


Figure 5. Example of how the trend-based stress index is calculated. The index is the ratio of the observed trend relative to the trend required such that the mean of the data at the end of the record sits outside the observed range of (de-trended) variability (John et al. 2022).

Calculation of condition scores for hydrological metrics.

As described above, the stress metric provides a deviation from baseline for each inland, natural wetland in the VWI. Both increasing and decreasing hydrological metrics were considered to be a threat to wetland condition, capturing changes to wetland water regimes from inflowing stormwater or conversion of intermittent wetlands to permanent inundation for water storage purposes. The stress metrics provided by John et al. (2023) were assigned to condition categories as follows:

Land use intensity score	Condition score	Condition class
-0.5 to 0.5	5	Excellent
-1.0 to -0.5 and 1.0 to 0.5	4	Good
-2 to -1 and 2 to 1	3	Moderate
-3 to -2 and 3 to 2	2	Poor
< -3 or > 3	1	Very poor

The four metrics of the hydrology sub-index were averaged to provide an overall score for hydrology.

Addressing altered hydrology with environmental water

Water for the environment is used to improve the environmental values and health of water ecosystems. Water for the environment aims to replace some of the essential flows rivers had before they were regulated with dams, weirs and channels. The water is released when rivers and wetlands need it most to counter the impacts of reduced natural flows.

Water for the environment aims to:

- cue fish migration and breeding
- improve water quality
- improve the condition of floodplain trees
- trigger the growth of wetland plants
- provide feeding and nesting habitats for waterbirds maintain flows or permanent pools in rivers that could dry out.

Meeting the essential water needs of rivers, creeks, wetlands and floodplains also benefits community wellbeing. There are demonstrated social and economic benefits when environmental watering supports places and waterways where people love to relax, play, and connect with nature. The primary purpose of environmental watering continues to be maximising environmental benefit. Where consistent with this objective, waterway managers must also consider whether social and cultural complementary benefits can be achieved.

Water for the environment is delivered in 19 water supply systems across Victoria under the VEWH's seasonal watering plan.

Water availability varies from year to year, and is allocated depending on entitlement rules, seasonal conditions like rainfall and run-off in catchments, and water already available in storages.

To find out about current environmental water entitlements held by the VEWH visit our water holdings.

Text Box 3. Addressing altered hydrology with environmental water.

2.2.6 Soils Sub-index

Wetland soils, often referred to as hydric soils, form through inundation processes which alter their physical and chemical characteristics. Hydric soils are characterised by periods of anerobic conditions and inhibition of oxygen transfer (Mitsch and Gosselink 2007). Wetland soils in intermittent wetlands cycle through periods of anaerobic and aerobic conditions as soils are inundated and then dry. This is important for several ecological and biogeochemical processes. In addition, soil particulates can bind heavy metals and other toxicants making them less available for uptake by aquatic biota (Matagi et al. 1998).

Wetland soils commonly have increased organic matter content as prolonged inundation slows organic matter decomposition (Jackson et al. 2019). Wetland soils are important for supporting wetland biota, particularly wetland vegetation, microbes and invertebrates.

Many wetland soils are highly susceptible to disturbance and slow to recover (Figure 6). Soil compaction from vehicles or livestock reduces oxygen availability and interferes with nutrient cycling (Jackson et al. 2019). Some wetland soil types, such as alpine peatlands are particularly vulnerable to drying, fire and physical damage (French et al. 2016).

Many wetlands in Victoria are characterised as having high levels of reduced inorganic sulfur (Hall et al. 2006). Prolonged drying and disturbance of these soils can lead to the formation of sulfuric acid upon rewetting. This can lead to low pH, impacting on vulnerable biota such as frogs, as well as the release of heavy metals from sediment stores (Glover et al. 2011, Taylor 2011).

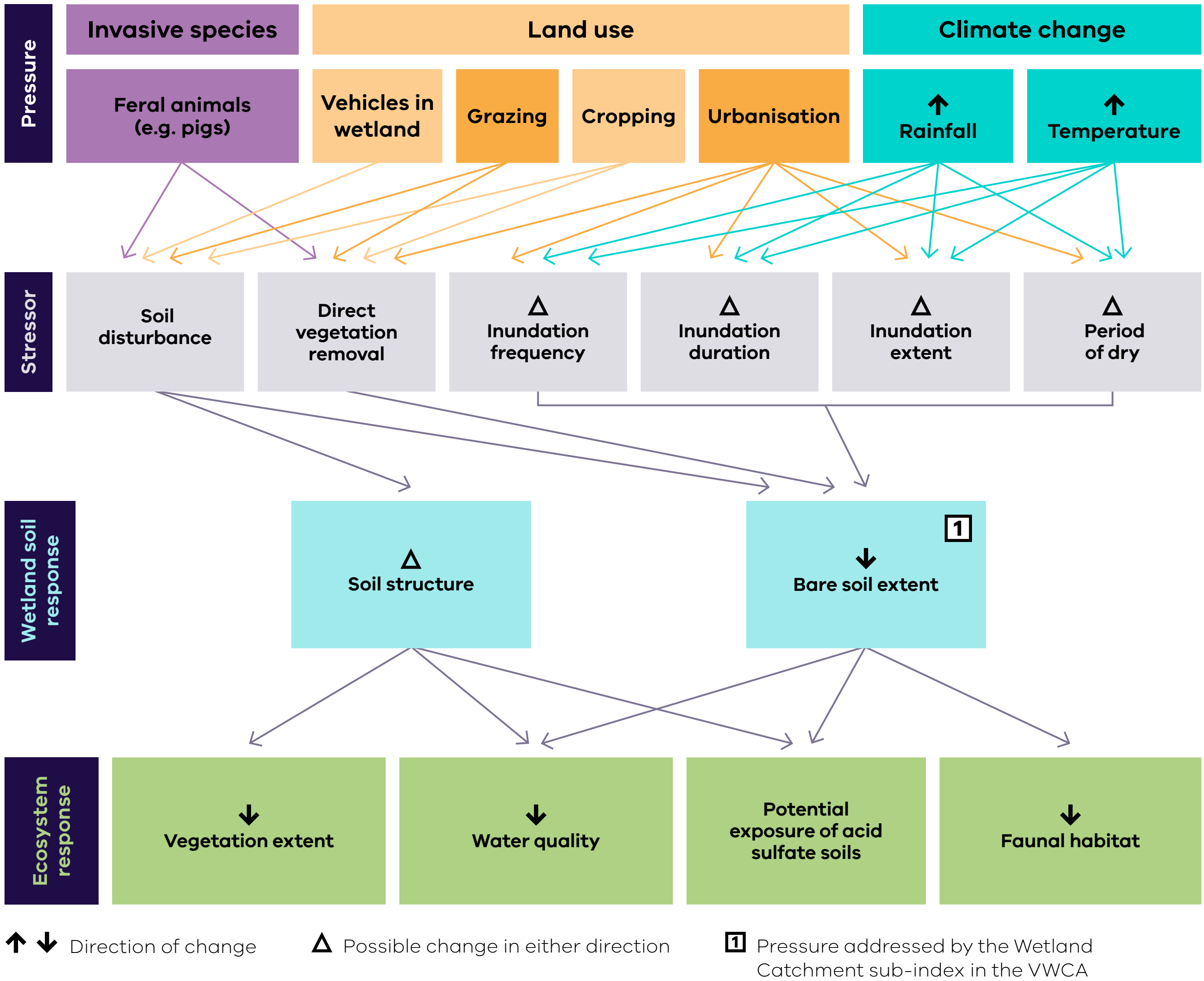


Figure 6. Conceptual diagram depicting the main pathways (arrows linking boxes) by which the threat (pressures) of land use, invasive species and climate change can link to soil related stressors and wetland soil and biotic responses. The numbered box indicates the stressor addressed by the Soil sub-index in the VWCA. Arrows within boxes indicate the direction of change; Δ indicates a possible change in either direction.

Source data

The calculation of condition scores for soils follows the same method as developed by the Commonwealth of Australia (2023) for vegetation condition, applied to bare soil extent. Consistent with approaches for ecosystem condition assessment and assessments of climate change (e.g. Hansen et al. 2010, DEE 2017) a deviation from baseline approach was adopted for extent of bare soil. The spatial metrics were derived from the archive of Landsat imagery for the period 1986 to 2024. The baseline period was discussed with experts, with a decision made to establish the baseline as the entire period of record, excluding the Millennium Drought. The exclusion of the Millennium Drought was considered appropriate as it represents a significant proportion (a little under one third) of the Landsat record. Including a large period of dry conditions in the baseline would bias the baseline towards drought conditions and reduce sensitivity to detect periods of increased water stress and associated changes in soil condition. The baseline period is 1986 to 2000 and 2010 to 2024 (inclusive).

The soil sub-index was calculated as the difference between annual metric values and the long-term average (baseline) for each wetland standardised by the inter-annual variability represented by the standard deviation (SD). Condition is represented by the average deviation from the baseline in the preceding five years (2019 to 2024) adjusted by the trend (trajectory slope) over the last two years (2023 – 2024).

Condition = (5-year average deviation) + (2-year trend).

This approach considering the mean and the trend recognises the differences between a wetland that is in poor condition and declining, compared to a wetland that may be still exhibiting indicators of poor condition but may be on a trajectory of rapid improvement, e.g. as happens when wetlands refill or floodplains that are inundated after periods of extended dry conditions.

Calculation of condition scores

As described above, the condition calculation provides a deviation from baseline for each inland, natural wetland in the VWI. Only increases in bare soil extent were considered as indicators of declining condition. The exception to this is extreme changes in extent (> 3 SD), which were considered to represent very poor condition regardless of the direction of change. This is consistent with Shewhart control chart limits (Montgomery 2020).

Soil scores	Condition score	Condition class
< 0, but > -3	5	Excellent
> 0 to 1	4	Good
>1 to 2	3	Moderate
>2 to 3	2	Poor
< -3 SD or >+3 SD	1	Very poor

2.2.7 Vegetation sub-index

Wetlands support a diversity of biota that are specifically adapted to complete all or part of their lifecycles in aquatic environments. This includes phytoplankton, wetland vegetation, invertebrates, fish, frogs, reptiles, birds and mammals. Landscape-scale, remote sensing data is only available for one group of wetland biota: wetland vegetation.

In addition to intrinsic biodiversity values, wetland vegetation serves a number of important functions within wetlands including (Brock and Casanova 1997):

- Provision of food – as primary producers, aquatic plants, along with phytoplankton, form the basis of the food chain within a wetland. Grazers include waterbirds, macroinvertebrates, fish, frogs, turtles and terrestrial animals.
- Provision of shelter - aquatic plants provide habitat for breeding, roosting and evasion of predators for a large range of aquatic fauna.
- Sediment binding – aquatic plants can play an important role in erosion control and the buffering of wetlands from high velocity inflows. In addition, plants can trap fine sediments and particles form the water column and inhibit re-suspension, resulting in increased water clarity.
- Buffering catchment runoff – fringing aquatic vegetation plays an important role in the trapping of particulate matter and uptake of nutrients and pollutants from overland run-off from surrounding catchment. This can lead to significant improvement in water quality within the body of the wetland.
- Regulation of water temperature – overhanging fringing vegetation can shade the water column in both flowing and non-flowing wetland systems, maintaining the temperature of the water column for aquatic fauna.

Vegetation type, extent, condition and nativeness are all sensitive to the pressures of land use change, invasive species and the impacts of climate change (Figure 7). The vegetation sub-index is assessed through change in vegetation extent (green vegetation, brown vegetation and inundated vegetation).

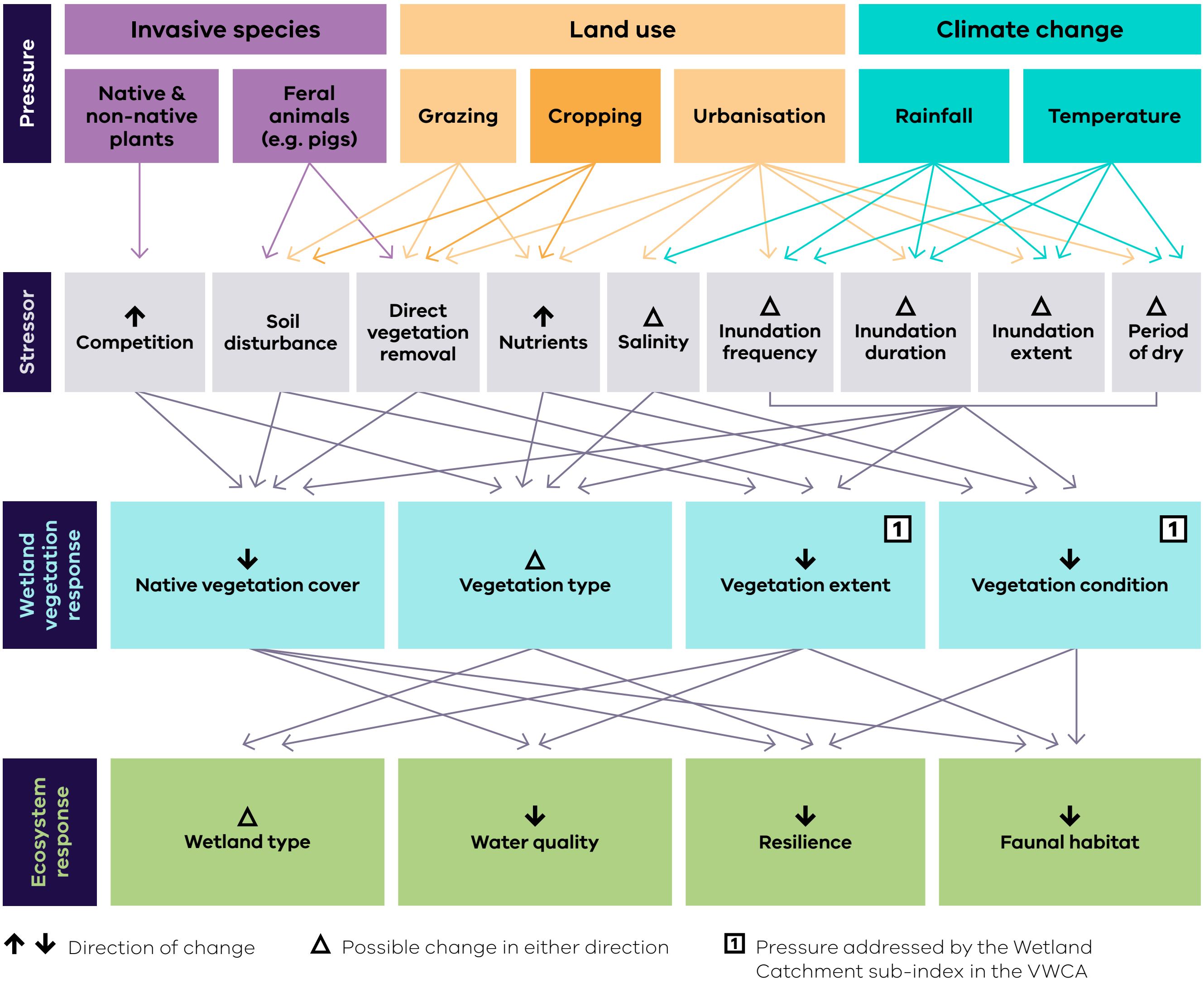


Figure 7. Conceptual diagram depicting the main pathways (arrows linking boxes) by which the threat (pressures) of land use, invasive species and climate change can link to vegetation related stressors and wetland vegetation and biotic responses. The numbered boxes indicates the stressor addressed by the vegetation sub-index in the VWCA.

Source data

The calculation of condition scores for vegetation, follows the same method as developed by the Commonwealth of Australia (2023). Consistent with approaches for ecosystem condition assessment and assessments of climate change (e.g. Hansen et al. 2010, DEE 2017) a deviation from baseline approach was adopted for extent of vegetation. The spatial metrics were derived from the archive of Landsat imagery for the period 1986 to 2024. The baseline period was discussed with experts, with a decision made to establish the baseline as the entire period of record, excluding the Millennium Drought. The exclusion of the Millennium Drought was considered appropriate as it represents a significant proportion (a little under one third) of the Landsat record. Including a large period of dry conditions in the baseline would bias the baseline towards drought conditions and reduce sensitivity to detect periods of increased water stress and associated changes in condition. The baseline period is 1986 to 2000 and 2010 to 2024 (inclusive).

The vegetation sub-index was calculated as the difference between annual metric values and the long-term average (baseline) for each wetland standardised by the inter-annual variability represented by the standard deviation (SD).

Condition for vegetation is represented by the average deviation from the baseline in the preceding five years (2019 to 2024) adjusted by the trend (trajectory slope) over the last two years (2023–2024).

Condition = (5-year average deviation) + (2-year trend).

This approach considering the mean and the trend recognises the different imperative for intervention comparing a wetland that is in poor condition and declining, compared to a wetland that may be still exhibiting indicators of poor condition but may be on a trajectory of rapid improvement, e.g. as happens when wetlands refill or floodplains are inundated after periods of extended dry conditions.

Calculation of condition scores vegetation

As described above, the condition calculation provides a deviation from baseline for each inland, natural wetland in the VWI. Only decreases in vegetation extent were considered as indicators of declining condition. The exception to this is extreme changes in extent (> 3 SD), which were considered to represent very poor condition regardless of the direction of change. This is consistent with Shewhart control chart limits (Montgomery 2020).

Soil scores	Condition score	Condition class
> 0, but < 3	5	Excellent
< 0 to -1	4	Good
< -1 to -2	3	Moderate
< -2 to -3	2	Poor
< -3 SD or >+3 SD	1	Very poor

2.3 VWCA Score calculation

2.3.1 VWCA scoring

The sub-indices of the VWCA were combined to provide an overall score by using the Inverse Ranking Transformation approach. This approach was used in the ISC and IEC (DEPI 2013, DELWP 2021b). The transformation is valuable because it recognises that a particularly low score for one sub-index is likely to involve one or more pressures and stressors that constrain ecological condition even if the other sub-indices score highly. In such cases, the inverse ranking transformation results in a lowered VWCA score.

To calculate the inverse ranking score, the four sub-index scores were placed in ascending order. The lowest score was multiplied by 4, the next lowest score by 3, and so on until reaching the highest score which was multiplied by 1. The totals were then summed to produce a score out of 50. If necessary, this score was rounded to the nearest whole number. An example of the application of the inverse ranking transformation to calculating an overall VWCA score is provided in Table 5.

Table 5. Example of the application of the inverse ranking transformation to calculating an overall IEC score.

Sub-index score (out of 5) ranked lowest to highest among the four sub-indices for a given wetland	Multiplied by	New score
2	4	8
3	3	9
3	2	6
5	1	5
	Total (out of 50)	**28**

2.3.2 VWCA condition classes

Once the inverse ranking transformation was applied and an overall VWCA score out of 50 calculated, wetlands were assigned to one of five condition classes (Table 6). The condition class is used to communicate the overall condition of the wetlands in a given region. Although this condition class is useful to convey an overview of wetland condition, the scores of the sub-indices and their underlying metrics capture key information and should also be examined.

Table 6. The thresholds of the overall VWCA scores and their corresponding condition classes.

Overall IEC Score	VWCA Condition Class
41–50	Excellent
34–40	Good
27–33	Moderate
20–26	Poor
10–19	Very Poor

2.3.3 Spatial aggregation and presentation of results

The VWCA is a landscape scale assessment, and the results are presented as area-weighted averages across several spatial scales:

- Whole of Victoria
- Catchment Regions
- River basins
- Land tenure (public vs private land)
- Wetland landscapes (regions of similar elevation, rainfall and geomorphology developed in the IWC; see Appendix A)

Area weighted averages were calculated as follows:

Σ (individual wetland score x wetland area) / total wetland area within a given spatial unit.

2.4 Limitations of the VWCA

Ecological systems are complex, and ecological data are characterised by many different types of uncertainty arising from both natural variability and from imperfect knowledge (Figure 8). Natural variability is a feature of ecological systems and there will be variability in ecosystems both over space and time. Uncertainty associated with natural variability does not decrease with increased sample sizes or by having census data; but our ability to characterise the natural variability can be improved with increased data. Knowledge uncertainty is due to imperfect understanding and includes not only measurement error, but also errors associated with imperfect models and the selection of the best available model.

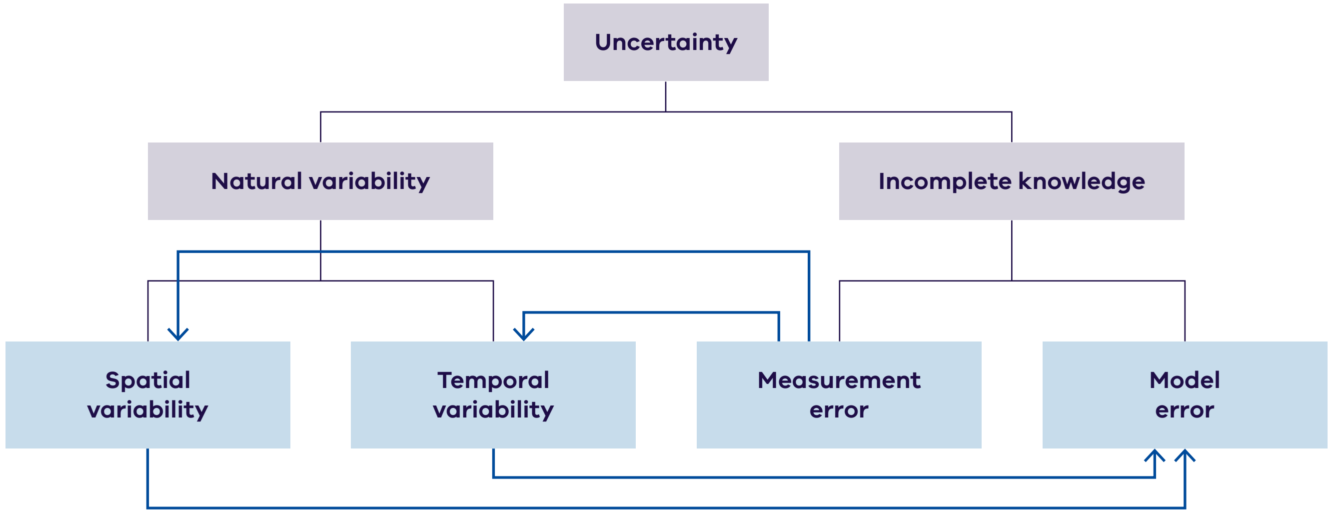


Figure 8. Sources of uncertainty in ecological studies. Arrows indicate sources of uncertainty that contribute to other sources of uncertainty. Adapted from Yanai et al. 2018.

Uncertainties associated with the VWCA arise from several sources. Natural variability is a major source of uncertainty. For example, the vegetation sub-index uses the extent of green vegetation as an indicator of condition. At some wetlands this may represent native, aquatic vegetation, but at other wetlands, there may be invasive wetland plants or encroachment of terrestrial vegetation which would all be classed as "green vegetation".

There is also uncertainty associated with available data representing actual conditions, with measurement errors and model errors both contributing. As all of the sub-indices are reliant on satellite data, they have the same issues with respect to cloud cover and misclassification of individual of pixels (see Text Box 4 for an example).

This landscape scale assessment is coarse in nature and is not suitable for assessing fine-scale trends in individual wetland condition. Consequently, the VWCA is not appropriate for the evaluation of management interventions or to provide detailed understanding of the complexities of how particular wetlands function or respond to particular threats.

Credit: Sean Phillipson EGCMA

Uncertainties associated with the Wetlands Insight Tool (WIT)

The WIT provides a powerful tool for capturing the long-term variation in hydrology, bare soil and vegetation cover and formed the basis for three of the four sub-indices of the VWCA (hydrology, soil and vegetation). The WIT is limited to clear observations of the earth surface by Landsat and therefore cannot map peak inundation that often occurs on cloudy days (Figure 9). In this example, there are several instances of "truncated" peaks due to cloud cover. For example, in 2016, the maximum WIT estimation of inundated vegetation was 55% of one of the large swamps in Barmah Forest. Site Managers used a combination of field measures and modelling to estimate that 97% of the wetland was inundated during those flood events.

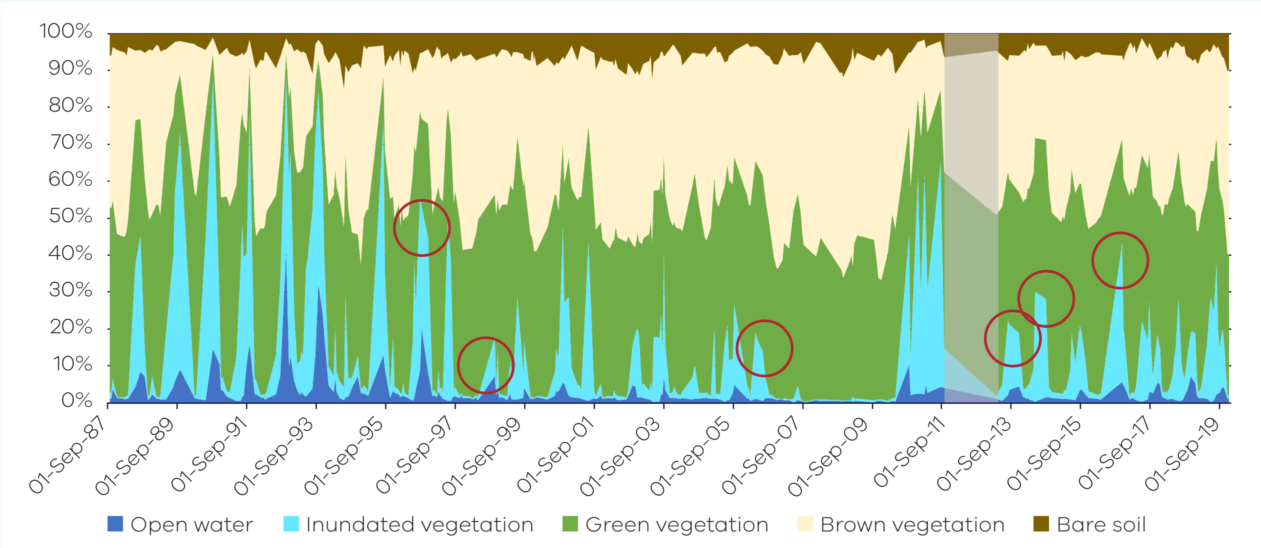


Figure 9. Complete WIT percentage inundation for a wetland in Barmah Forest. Truncated peaks (circled) potentially indicate missing peak inundation on cloudy days. This "plateau" pattern was not observed in 2016 because the entire rising limb during the four months prior to the peak is not detected. The greyed out section represents a period between late 2011 and early 2013 when Landsat failures led to no imagery.

The underestimation of peak inundation will be greatest at "flashy" sites where inundation recedes rapidly (before the next clear satellite view). In addition, the WIT outputs are missing for a portion of the record (usually between 2011 to 2012) due to Landsat 7's failed scan line corrector (Dunn et al. 2019).

The number of observations available in a given year from the WIT is highly variable. At some sites, such as at Johnson Swamp in the Kerang Wetlands, there are generally multiple observations available each year, and an average of 19.4 observation dates annually. In contrast, at larger sites, there may be fewer than 10 observations in a year. This limits the utility of the WIT (and other satellite data products) with respect to calculating finer time-scale metrics.

Text Box 4. Uncertainties associated with the WIT (Commonwealth of Australia 2023).

Not all components that are important for wetland function and potential indicators of wetland condition were included in this assessment, largely due to a lack of suitable, landscape-scale data. The lack of a wetland buffer measure, for example, affects the certainty of the wetland catchment sub-index as wetlands that are partially protected from higher intensity, adjacent land uses by a strip of dense native vegetation are not distinguished from wetlands that are fully exposed to threats from adjacent activities (Text Box 7).

2.5 Future Directions

This report provides the first state-wide assessment of the environmental condition of Victoria's wetlands. The intention is that the approach will be reviewed and improved to reflect improved knowledge of wetland ecosystem functioning, values and threatening processes for future assessments.

The same principles developed to guide refinement of the Index of Stream Condition (ISC) data collection methods (DEPI 2011) will be used for the VWCA. That is, changes to the methodology will only be made if: the new method is a demonstrable improvement on previous methods; there was a strong reason to integrate new methods with existing methods for continual improvement; the new method has been tested; and the new methods conforms to the criteria of being transparent, intuitive, with an appropriate balance of cost, speed, accuracy and scientific rigour (DEPI 2011).

Complementary investigations are underway, and may assist in refining or improving VWCA sub-indices in the future. This may include, for example, considering climate change projections for wetland water regime (Text Box 5), or new approaches to estimations of wetland loss (Text Box 6).

A mix of targeted surveillance monitoring, management intervention monitoring and strategic research is needed to support wetland management. Although the snapshot of environmental condition provided by the VWCA is valuable, it does not support the assessment of fine-scale trends in components of wetland ecosystems (section 2.4), evaluation of management interventions, nor advances detailed understanding of the complexities of how particular wetlands function. This detailed understanding, needed to manage Victoria's wetlands effectively, is best addressed with question-driven monitoring and research.

The next VWCA assessment is proposed to be undertaken around 2036. The proposed interval between assessments reflects the long timeframes expected for changes in landscape-scale environmental condition that can be detected with the methods used for statewide assessments. During the periods between statewide condition assessments, local management decisions will be informed by existing data on changing threats and contexts (e.g. changes in climate, land use), monitoring to evaluate the outcomes of management actions, and research to fill important knowledge gaps, with guidance from state and regional waterway policies and strategies.

Credit: Sean Phillipson EGCMA

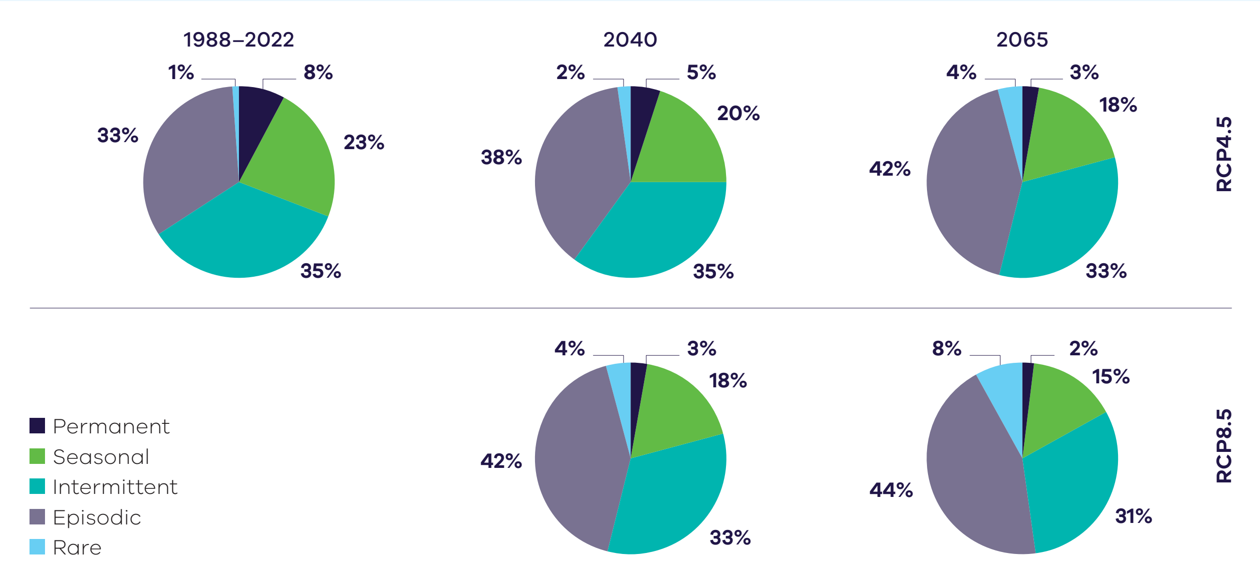
Climate change projections for wetland water regime

DEECA has been working with University of Melbourne to better understand the future impacts of climate change on wetlands in Victoria. These impacts are estimated by modelling the effect of a drying climate on wetland water regime and translating this to a change in water regime category and subcategory (see table below).

Water regime categories adopted in the Victorian wetland classification framework

				Subcategory description	
Wetland system	**Water regime category**	**Category description**	**Water regime subcategory**	**Frequency of inundation**	**Duration of inundation**
Lacustrine and palustrine	Permanent	Inundated constantly, rarely drying completely	–	Constant, annual or less frequently but before usually wetland dries.	Never dries or dries rarely (i.e. holds water at least 8 years in every 10), but levels may fluctuate within or between years.
	Periodically inundated	Inundated annually to infrequently, holding water for at least 1 month to more than 1 year before drying	Seasonal	Annual or near annual inundation (i.e. holds water at least 8 years in every 10)	Holds water 1–8 months, then dries
			Intermittent	Infrequent – holds water, on average, 3–<8 years in every 10	Holds water > 1 month to > 1 year, then dries
			Episodic	Infrequent – holds water, on average, less than 3 years in every 10	Holds water > 1 month to >1 year, then dries

The results (below) show a general drying trend under all scenarios, with the drier wetland types increasing and making up a greater proportion of wetlands overall. The figure below shows the trend for a reduction in the proportion of permanent and seasonal wetlands and an increase of episodic wetlands under emission scenarios RCP4.5 and RCP8.5 for the years 2040 and 2025.

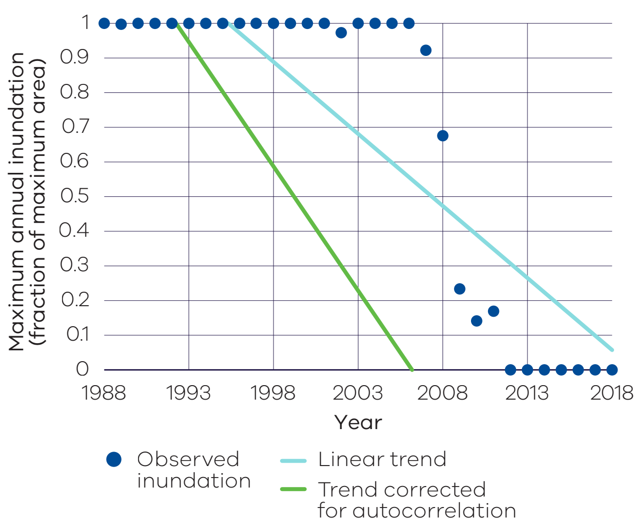


Statewide distribution of wetland types (based on water regime) under different climate change scenarios

Text Box 5. Effects of climate change on wetlands (John et al. 2024).

Are there wetlands that are no longer being inundated?

The altered wetland water regimes project also assessed changes in wetland area between 1988 and 2022 using a combination of linear (for wetlands with long term gradual trends) and non-linear (for wetlands with step changes) regression models (John 2024). This analysis identified 2,834 individual wetlands that may have been lost from 1988 to 2023 because they no longer experience inundation. This represents approximately 4% of individual wetlands identified in Victoria. Most of these wetlands were located in the Mallee, Wimmera and North Central regions. Around 90% were classified as episodic systems, where inundation is naturally highly variable. Further work is required to investigate the drivers for these trends, particularly whether they are from climate change or human intervention.



An example, from real data, of a wetland that has experienced a step change in inundation, beginning in 2009. Since 2012 no inundation has been detected.

Text Box 6. Wetlands that are no longer inundated (John 2024), including a figure illustrating applications of the method to a wetland that has experienced a step change in inundation.

3 Condition of Victorian Wetlands

3.1 State-wide overview of wetland condition

The VWCA was applied to 32,456 natural inland wetlands in Victoria covering an area of 488,203 hectares. The Victorian Wetland Inventory (VWI) published in 2025 was used to identify the wetlands in scope for the VWCA (DataVIC).

Thirteen percent of wetland area across Victoria was in excellent condition, 11% in good condition, 30% in moderate condition, 26 % in poor condition and 6% in very poor condition (Figure 10).

While there were wetlands in all regions of the state in excellent to very poor condition, on average, wetlands were in better condition in Gippsland, moderate in the central and northern areas and poor around the major cities of Melbourne and Geelong as well as parts of the western plains (Figure 11).

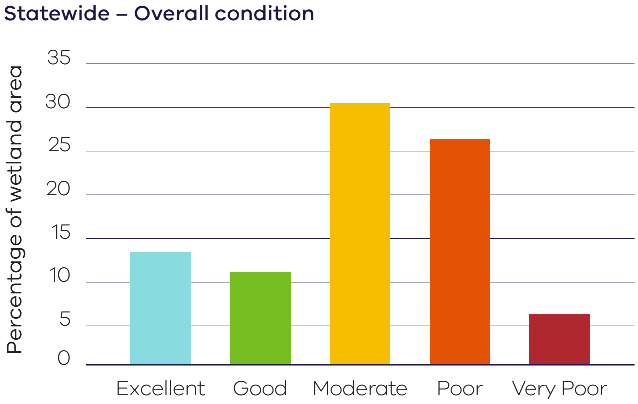


Figure 10. The percentage of wetland area in each overall condition score class for Victoria. The area is the combined extent of mapped, inland wetlands that are not classified as dams.

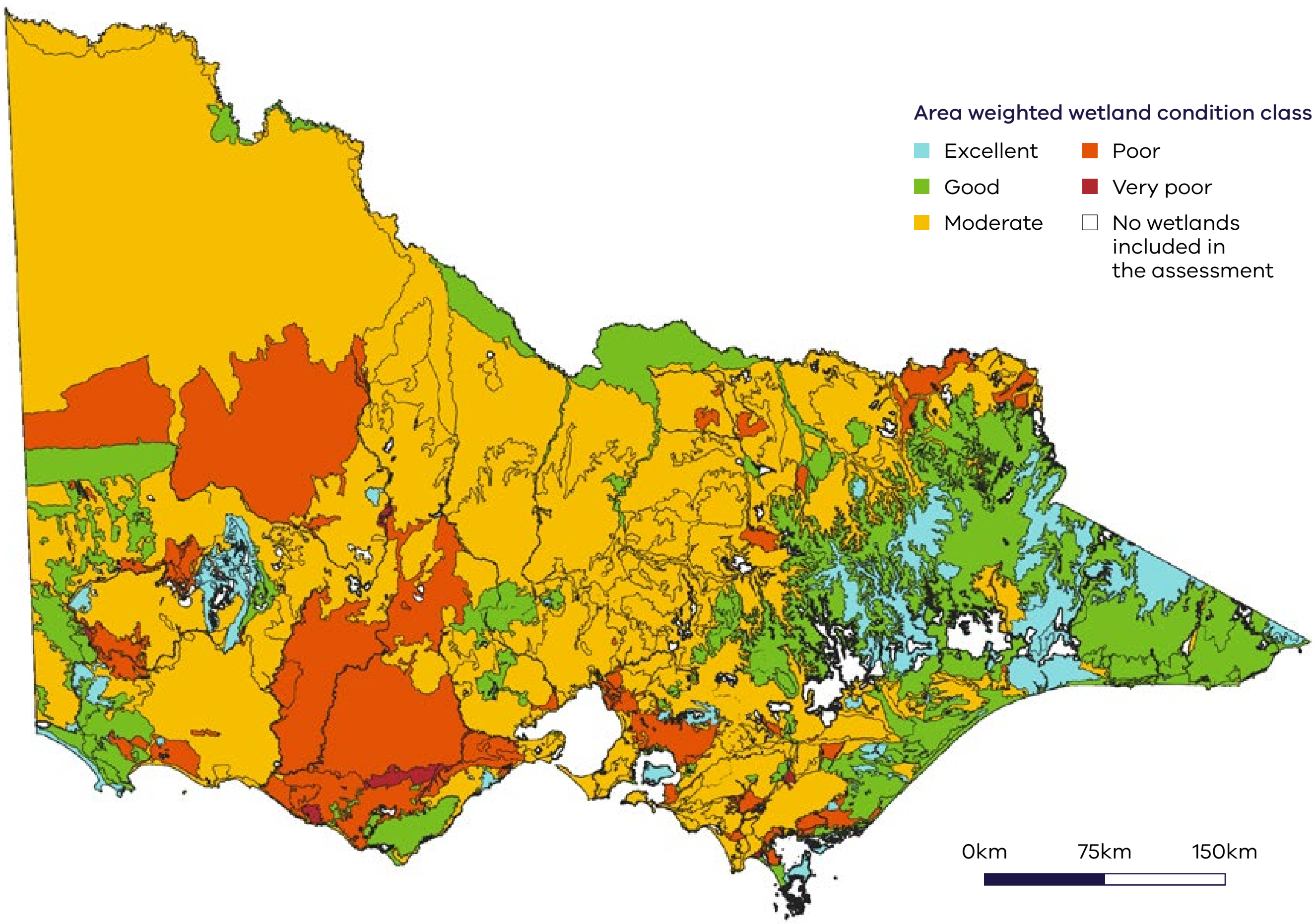


Figure 11. Area-weighted wetland condition for Victorian Wetland Landscape Profiles in Victoria (see Appendix A for landscape profile descriptions).

Around a quarter of natural inland wetlands by number and 40% of wetland area in Victoria is on public land, largely in reserves managed for conservation. On average, wetlands on public land are in better condition with one third wetland area in excellent condition, compared to just 2% of wetland area on private land (Table 7).

Table 7. The percentage of wetland extent in each overall condition score class for wetlands on public and private land in Victoria. The extent is the combined extent of mapped, inland wetlands that are not classified as dams. "No." equals the number of wetlands assessed.

	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Private	291,437	25,101	2	10	37	39	12
Public	196,736	7,356	34	16	32	18	1

Wetland condition varied considerably across catchment regions (Table 8). On average, wetlands in East and West Gippsland were mostly in excellent or good condition, reflecting the large areas of native vegetation remaining in these regions and, particularly in East Gippsland, fewer wetlands subject to significant water resource use. In contrast, wetlands in the Corangamite and to a lesser extent, Glenelg-Hopkins and Wimmera regions, had a significant proportion of wetland area in poor or very poor condition. This reflects the large extent of wetlands in these regions that are surrounded by moderate to high intensity land uses, water resource use and the pronounced effect of climate change parts of these regions are already experiencing (Tolhurst et al. 2023).

Table 8. The percentage of wetland extent in each Region in each overall condition class. The extent is the combined extent of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

CMA	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Corangamite	52718	2473	1	3	38	37	19
East Gippsland	8843	1360	48	28	23	1	< 1
Goulburn-Broken	66194	4228	38	12	23	24	2
Glenelg-Hopkins	116356	7866	12	8	33	34	11
Mallee	37775	1600	8	33	39	15	5
North Central	99799	2603	10	8	40	38	4
North East	14156	3388	19	24	46	9	1
Port Phillip and Western Port	5041	1813	8	15	48	26	3
Wimmera	61082	3484	3	11	43	39	4
West Gippsland	25657	3642	45	20	16	10	9

There were examples of all wetland types in excellent to very poor condition, but area-weighted averages indicate that peatlands are, on average, in excellent condition (Table 9). Temporary Tall Marshes were also on average, in excellent condition, but there are relatively few examples of this wetland type in Victoria, with only 32 in the VWI. Permanent Lignum Swamps and Permanent Saline Lakes are examples of wetland types with decreased magnitude, frequency and duration of inundation. Generally, a large proportion of wetland area for most wetland types scored good or excellent for the "dry fraction" metric of the hydrology sub-index which describes the proportion of the year with no water extent (John et al. 2024). This finding makes sense in the context of the landscape-scale area weighted approach used in the VWCA, as large wetlands are generally more likely to hold some water during dry periods than smaller wetlands (see section 3.3 for further detail). In addition, many wetlands will experience periods of dryness relatively often as an inherent feature of their hydrological regime.

Recent work by John (2024) investigated wetland loss in Victoria between 1988 and 2023 by analysing annual maximum inundation extents. The analysis found that 4% of Victoria's wetlands may have been lost. Lost wetlands tended to be more variable to begin with, with more losses across intermittent or episodic wetlands. Results of this work showed that very few permanent wetlands have been lost. There are larger uncertainties involved with assessing the loss of episodic wetlands due to their extreme intermittence. Most lost wetlands are in north-western Victoria – especially the Mallee, Wimmera and North Central regions (see text box 6). It is important to note that the VWCA does not include annual maximum inundation extent as a metric or analyse whether identified areas of wetlands have been 'lost' using the methods of John (2024).

Table 9. Area-weighted average condition scores based on VWI wetland type in Victoria. Sub-indices are scored out of 5 and the overall score is out of a maximum possible of 50. The four hydrological metrics are shown separately: Magnitude of inundation, duration of inundation, frequency of inundation and the proportion of time a wetland is dry (dry fraction). These are combined into a single overall hydrological sub-index score before the final overall condition scores are calculated. Red = very poor, orange = poor, yellow = good, green = very good, blue = excellent

			Hydrology metrics								
Wetland type	Extent (ha)	No.	Magnitude	Duration	Frequency	Dry Fraction	Hydro sub-index.	Soil sub-index	Vegetation sub-index	Land Use sub-index	Overall score
Peatlands	4386	2521	4.1	4.1	4.3	4.1	4.2	4.1	4.9	4.9	44
Permanent freshwater lake	30332	397	3.5	3.1	3.8	4.3	3.7	4.4	4.5	1.8	32
Permanent freshwater marsh or meadow	2663	169	4.0	3.9	4.1	4.5	4.1	3.9	4.5	3.1	37
Permanent freshwater swamp	1677	241	3.2	2.9	3.1	4.3	3.4	4.6	4.7	3.8	39
Permanent paperbark swamp	570	41	4.2	4.6	3.7	4.0	4.1	4.3	3.6	3.2	36
Permanent river red gum swamp	6775	131	2.5	2.7	2.7	4.0	3.0	3.1	5.0	3.3	33
Permanent saline lake	79181	180	3.0	2.4	2.3	4.1	3.0	3.3	4.3	2.5	30
Permanent saline wetland	12089	38	3.8	4.4	4.4	3.5	4.0	4.8	3.7	4.2	40
Permanent salt marsh	3559	59	3.7	4.0	4.2	3.6	3.9	4.3	4.2	3.2	37
Permanent shallow wetland/claypan	2378	189	3.6	3.7	3.8	3.7	3.7	4.6	4.4	2.9	36
Permanent shrub swamp	963	54	3.3	2.8	3.6	2.8	3.1	4.6	4.9	3.0	36
Permanent tall marsh	458	12	3.1	3.1	3.1	4.0	3.3	4.1	5.0	4.2	39
Temporary black box swamp	234	34	4.4	4.1	3.5	4.0	4.0	2.9	3.8	2.9	32
Temporary freshwater lake	101856	2684	3.1	3.0	3.3	3.9	3.3	3.3	4.2	2.0	29
Temporary freshwater marsh or meadow	52859	5399	3.6	3.6	3.8	4.2	3.8	3.4	4.2	2.0	30
Temporary freshwater swamp	23902	5356	3.8	3.8	3.9	3.9	3.9	3.5	4.3	2.1	31
Temporary lignum swamp	25460	839	3.1	2.9	3.2	3.9	3.2	3.2	4.0	1.7	27
Temporary paperbark swamp	4621	566	3.8	3.8	4.2	4.0	4.0	3.5	4.3	2.0	31
Temporary river red gum swamp	71620	3713	3.1	3.4	3.8	4.3	3.7	3.9	4.6	3.2	36
Temporary saline lake	18377	466	3.4	3.4	3.5	4.0	3.6	3.4	4.4	2.0	30
Temporary saline swamp	7683	205	2.9	3.1	3.5	3.6	3.3	3.7	4.3	2.3	31
Temporary salt marsh	6476	212	2.9	3.1	3.5	4.1	3.4	3.4	3.7	2.3	30
Temporary shallow wetland/claypan	73181	7053	3.9	3.8	4.0	4.0	3.9	3.5	4.0	2.0	30
Temporary shrub swamp	26091	1869	3.9	3.9	3.8	3.8	3.9	4.1	4.5	3.7	39
Temporary tall marsh	1671	32	4.3	4.1	4.8	4.0	4.3	4.9	4.4	4.5	44

3.2 Wetland catchment – land use

As of 2019, Around 48% of Victoria remained covered in some form of native vegetation, with almost eight million hectares covered in native forests, in the 2015–2019 epoch (Figure 12). The eastern and northeastern alpine areas in particular are heavily forested. Although there was substantial tree loss from wildfires in the summer of 2019–2020, recent data suggests that tree cover has largely recovered (Guerschman 2023). Around half of Victoria is used for agriculture, mainly dryland cropping and pasture, which each cover more than five million hectares.

Despite the relatively large area of native vegetation remaining in Victoria, the majority of the wetland area is in lowland, agricultural landscapes. As a consequence, around 60% of wetland area in Victoria scored poor or very poor for wetland catchment (Figure 13).

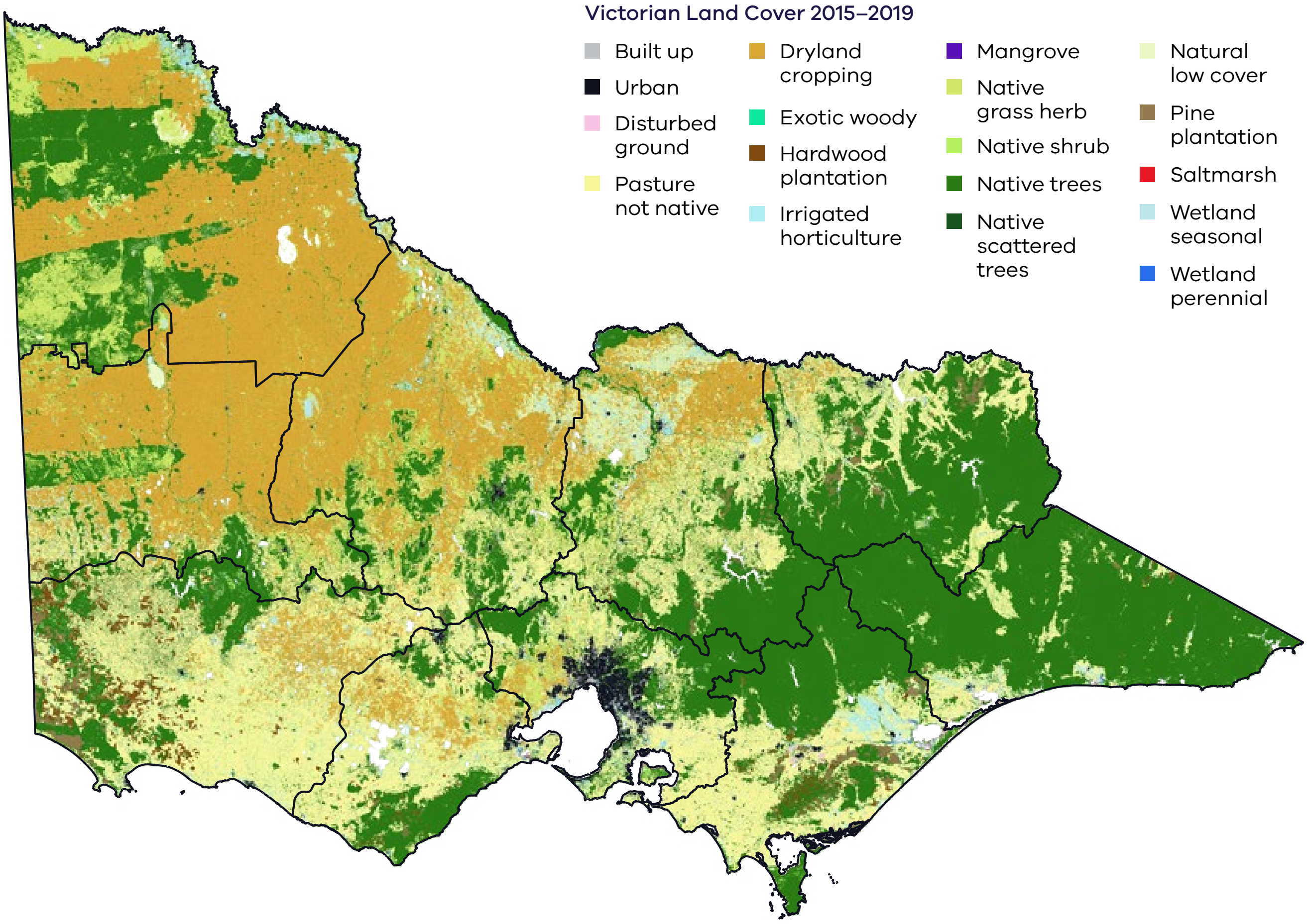


Figure 12. Victorian Land Cover Time Series (2015–2019) in Victoria (White et al. 2020).

Statewide – Land Use

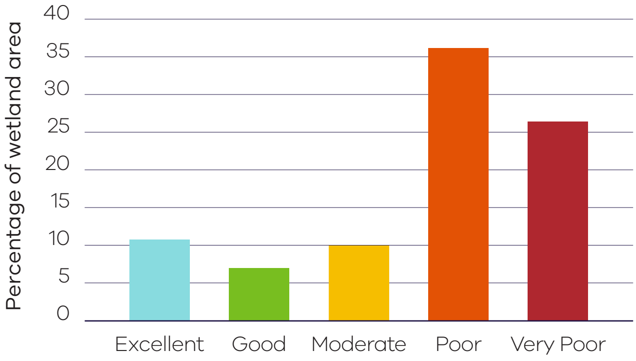


Figure 13. The proportion of wetland extent in each condition score class across Victoria for the catchment sub-index.

Although many wetland types are found in both high intensity and low intensity land use landscapes, there are some patterns with respect to wetland type and the wetland catchment sub-index (Appendix B, Table 44). For example, unsurprisingly, peatlands, which are alpine wetlands, are largely surrounded by native vegetation and 99% of peatland area scored excellent or good for the wetland catchment sub-index. Conversely, around 80% of the area of permanent and temporary saline lakes and temporary lignum swamps scored poor or very poor for wetland catchment, indicating that they are often surrounded by high intensity land uses.

It should be noted, however, that the wetland catchment sub-index is only an indication of land use intensity within one kilometre of each wetland. It does not take into account the presence of wetland buffers that could mitigate some of the impacts of high intensity land use on wetland condition (see Text Box 7).

In terms of regions, there are large differences in wetland catchment sub-index scores across the State (Table 10). East Gippsland has two thirds of its wetland area (66%) surrounded by lower intensity land use, reflecting the large amounts of native vegetation remaining in this region. It should be noted, however, that East Gippsland region contains < 2% of the total inland, natural wetland area in Victoria. Large percentages of wetland area scored very poor for Wetland catchment in Corangamite (56%), Glenelg-Hopkins (44%) and Melbourne Water (46%) regions. While these low scores largely reflect high intensity agricultural land uses, in the Melbourne Water and Corangamite regions there are also significant wetland areas surrounded by urban land use in the cities of Melbourne and Geelong.

Table 10. The percentage of wetland extent in each Region in each condition class for the wetland catchment sub-index. The extent is the combined extent of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

CMA	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Corangamite	52718	2473	1	1	7	35	56
East Gippsland	8843	1360	61	5	7	21	5
Goulburn-Broken	66194	4228	23	21	7	31	17
Glenelg-Hopkins	116356	7866	10	6	6	35	44
Mallee	37775	1600	8	19	34	19	20
North Central	99799	2603	9	2	7	56	26
North East	14156	3388	15	11	15	36	22
Port Phillip and Western Port	5041	1813	8	4	8	34	46
Wimmera	61082	3484	3	4	24	42	27
West Gippsland	25657	3642	45	20	16	10	9

The importance of wetland buffers

Wetland buffers are an area of native vegetation adjacent to a wetland that separates human activities from the wetland and lessens the adverse impact of human disturbance (Martino 2001). Wetland buffers perform a wide range of functions such as provision of habitat and habitat connectivity and protecting the wetland from the impacts of adjacent land uses.

Intense urbanisation and agricultural activities and intensive forestry operations have been shown to significantly influence the amount of sediment and contaminants in surface water runoff, alter hydrology, and to increase variation in water levels of wetlands during storm events (e.g. Muscutt et al. 1992, Norris 1993, Parkyn et al. 2004, Moreno-Mateos et al. 2008, Watson et al. 2010, Palmer 2013). A wetland buffer can help to reduce pollutant loads into wetland systems, thereby protecting water quality within the wetland (McElfish et al. 2008a). Buffers can help to mitigate the pollutant loads to wetlands through several processes including interception of sediments (and attached nutrients and contaminants); uptake of nutrients (and some toxicants) into plant biomass; and biogeochemical transformation of pollutants into non-bioavailable forms (e.g. denitrification of dissolved inorganic nitrogen or oxidation of toxicants).

Buffers can also reduce disturbance of native fauna from adjacent activities. Disturbance (noise, light, movement) from human activities can be deleterious to a variety of wetland biota. Wetland fauna, particularly waterbirds, can perceive people and domestic animals as potential predators causing alarm and triggering avoidance behaviour. This can affect the ability of some species to get enough energy from foraging, due to constant flight response, but can also disturb nesting behaviours and cause nest abandonment.

A wetland buffer can also act as a physical barrier to invasive plant propagules arriving by wind and water. Plant propagules can become trapped in the buffer preventing them reaching the wetland, thus creating a barrier to dispersal (Morris et al. 2012).

Text Box 7. Wetland buffers.

3.3 Hydrology

Around half (42–52%) of wetland area in Victoria scored excellent or good for magnitude, duration and frequency of inundation, indicating little change in these aspects of hydrology since the 1980s (Figure 14). Eighty percent of wetland area scored excellent or good for the dry fraction metric of the hydrology sub-index. This indicates that these wetland areas have not experienced trends in the periods for which they are completely dry that depart from existing variability (captured over the period of the Landsat record 1988–2022).

Those wetlands that scored moderate, poor or very poor in one or more hydrological metric of the hydrology sub-index, in general, experienced reduced magnitudes, extent and / or frequency of inundation. There is a smaller percentage of wetland area (around 3 – 5%) that experienced increases in inundation, which contributed to their scoring moderate, poor or very poor for this sub-index.

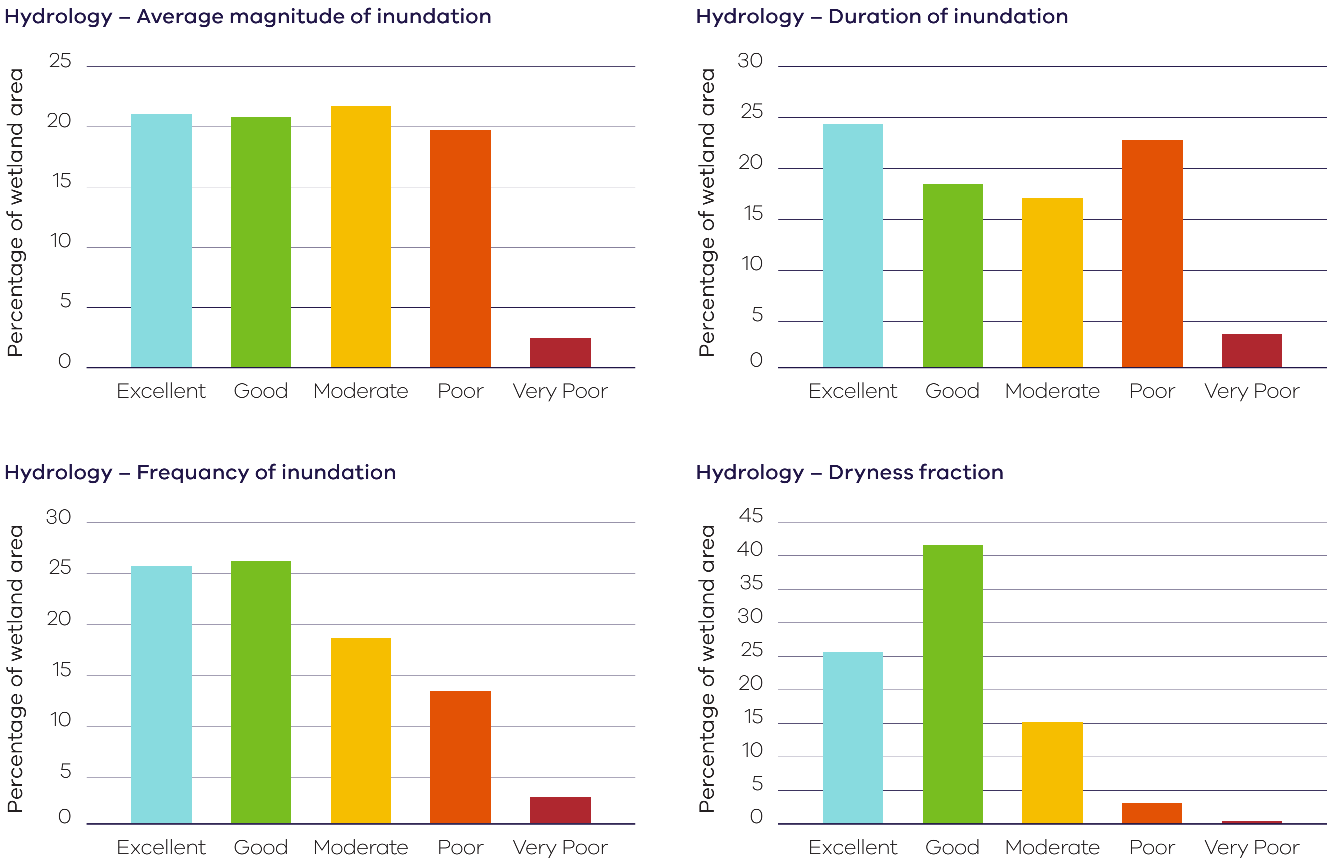


Figure 14. The percentage of wetland extent in each condition score class in Victoria for average magnitude of inundation (top left) and duration of inundation (top right), frequency of inundation (bottom left) and proportion of time a wetland is dry (bottom right).

In terms of wetland type, the majority of peatlands have low amounts of modification to hydrological regimes, with 58% of peatland area scoring excellent and 34% good for the hydrology sub-index (Appendix B, Table 45). Several permanent wetland types had large percentages (> 70%) of their extents that were assessed as excellent or good, including permanent freshwater lakes and permanent freshwater marshes or meadows. It is likely that many of these systems experienced changes to their hydrology (changing from temporary to permanent wetlands) prior to the Landsat record commencing in 1986.

While the majority of wetland area of temporary wetland systems was in good or excellent condition, over a third (35%) of the area of temporary freshwater lakes scored poor for hydrology, largely due to decreases in magnitude, duration and / or frequency of inundation. Temporary lignum swamps also, on average scored, moderate or worse for the hydrology sub-index due to reduction in inundation metrics.

Around half of the wetland area of permanent river red gum swamps scored very poor for the hydrology sub-index. This is heavily influenced by a single wetland (Winton Wetland) in the Goulburn-Broken region. This wetland was formerly a water storage (Lake Mokoan) that has recently undergone significant restoration. This included restoring the natural intermittent water regime, so while the VWCA has detected significant negative change in inundation at this wetland, in this instance, this is indicative of improved conditions (Text Box 9). This example reiterates that broad scale condition assessments are not particularly useful for evaluating management interventions, and different monitoring approaches are needed for this (Text Box 2).

Wetland hydrology sub-index scores followed a similar pattern across most CMAs, with more than half of wetland area scoring excellent or good for the combined four hydrological metrics, indicating that observed trends in hydrology metrics have not departed substantially from existing variation over the period of the Landsat record (1988–2022; Table 11). Four Regions (East Gippsland, Glenelg-Hopkins, North East and West Gippsland) scored excellent or good for > 80% of their wetland area. North Central and Wimmera Regions had more than a quarter of their respective wetland areas scoring poor or very poor for hydrology and this was largely due to decreases in inundation magnitude, frequency and / or duration. Since the end of 2022 (the conclusion of the data record used in the calculation of the Hydrology sub-index) some parts of Victoria have experienced very dry conditions (e.g., south west Victoria, including the Glenelg-Hopkins Region), with reduced rainfall and record-breaking dry spells. This means that the sub-index scores presented here may overestimate hydrological condition (see Text Box 8).

Around 10% of wetlands in the Melbourne Water region scored poor for hydrology, but in this region, over half the total wetland area has experienced increases in inundation reflecting the pressures of using wetlands for water storage and stormwater retention.

Table 11. The percentage of wetland extent in each Region in each condition class for the hydrology sub-index. The extent is the combined extent of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

Region	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Corangamite	52718	2473	27	32	29	8	4
East Gippsland	8843	1360	50	33	10	7	0
Goulburn-Broken	66194	4228	31	37	16	9	6
Glenelg-Hopkins	116356	7866	49	29	16	5	0
Mallee	37775	1600	46	17	26	7	2
North Central	99799	2603	33	23	16	25	1
North East	14156	3388	52	33	13	2	0
Port Phillip and Western Port	5041	1813	43	28	17	10	1
Wimmera	61082	3484	15	19	30	31	2
West Gippsland	25657	3642	57	32	6	3	1

Influence of wet and dry periods on hydrology sub-index results

The outputs of the University of Melbourne altered wetland water regimes work are influenced by the occurrence of drier periods such as droughts, and wetter periods such as La Niña events. The first time series of data analysed covered the period from 1988 to 2018. The second analysis used data from 1988 to 2022 (see results tabulated below), which included three very wet years. Between 2019 and 2022, two La Niña events brought above-average rainfall and cooler temperatures to Victoria, resulting in wetter-than-usual conditions and widespread flooding. The subset of metrics used in the hydrology sub-index of the Victorian Wetland Condition Assessment are marked with an asterisk (see section 2.2.5 Hydrology sub-index for more detail on the method).

Stress index	Proportion of wetlands substantially drier (%)	
	1988–2018	1988–2022
Magnitude (mean)*	20.8	13.9
Magnitude (maximum)	12.2	7.1
Duration*	23.0	16.4
Timing	1.5	1.1
Frequency*	14.8	9.7
Rate of change	2.8	1.7
Dryness fraction*	7.6	9.1

From these results, we can see that the stress metric scores were influenced by climatic conditions, as we would expect. Relative to the 1988–2018 results, analysis of the 1988–2022 time series showed an improvement across most of the stress metrics, indicating that the drying pattern had eased, at least in some areas.

Since the end of 2022 some parts of Victoria have experienced very dry conditions (e.g., south west Victoria, including the Glenelg-Hopkins Region), with reduced rainfall and record-breaking dry spells.

Because of this we would expect that the stress metric scores and the Hydrology sub-index scores of the VWCA presented in this report (which drew on data up to the end of 2022) would be an underestimation of the current level of hydrological stress for the wetlands in these regions.

Text Box 8. Wetland cycles of wetting and drying are captured in the VWCA method, but only up to 2022.

3.4 Soils

Around half of the wetland area across Victoria scored excellent (29%) or good (20%) for the soils sub-index indicating very little change in exposed soil in the wetland beds since the 1980s (Figure 15). A third of wetland area, however, scored poor (27%) or very poor (2%) for the soils sub-index indicating a significant (> two standard deviations from the median) increase in bare soil in the past five years.

Statewide – Soil

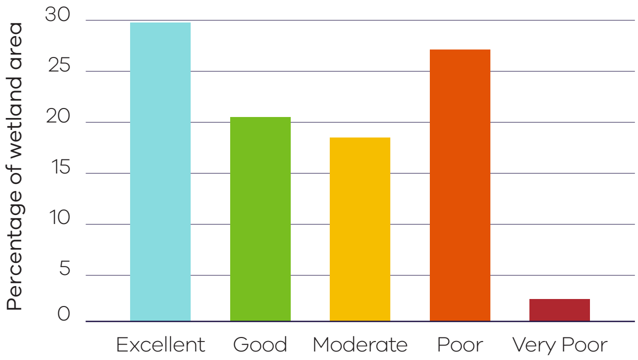


Figure 15. The proportion of wetland extent in each condition score class across Victoria for the soils sub-index.

Although there were examples of all wetland types in all condition classes for the soils sub-index, some types, were, on average more impacted than others (Appendix B, Table 46). While the majority of peatlands scored excellent (46%) or good (29%) for soils, around 10% of the total peatland area scored poor. These were largely located in the upper Latrobe, Thomson and Murray Rivers. More than a quarter of the total wetland area scored poor or very poor for several temporary wetland types including black box swamps, freshwater marshes or meadows, lignum swamps, paperbark swamps and saltmarsh.

In terms of CMA regions, there are large differences in soil sub-index scores across the State (Table 12). East and West Gippsland have the vast majority of their wetland area scoring excellent for the soils sub-index (79% and 88% respectively) indicting little change in exposed soils in the past five years compared to the last four decades. Over one third of wetland area scored poor or very poor for soils in Corangamite (39%) and Glenelg-Hopkins (33%) regions.

Table 12. The percentage of wetland extent in each Region in each condition class for the soils sub-index. The extent is the combined extent of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

Region	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Corangamite	52718	2473	27	19	15	35	4
East Gippsland	8843	1360	79	13	5	3	0
Goulburn-Broken	66194	4228	47	20	23	10	1
Glenelg-Hopkins	116356	7866	33	18	17	27	6
Mallee	37775	1600	16	41	25	18	0
North Central	99799	2603	20	30	34	16	1
North East	14156	3388	39	32	19	10	0
Port Phillip and Western Port	5041	1813	53	22	17	8	1
Wimmera	61082	3484	31	26	21	18	4
West Gippsland	25657	3642	88	7	3	2	0

3.5 Vegetation

Over two thirds of the wetland area across Victoria scored excellent (49%) or good (18%) for the vegetation sub-index indicating very little change in the extent of green, brown and inundated vegetation in the assessed wetlands since the 1980s (Figure 16). Sixteen percent of wetland area scored poor for vegetation, indicating a significant decline in the extent of green, brown and inundated vegetation in the past five years. The wetlands that scored poor were distributed across all wetland types, with the majority of wetland area for each type scoring excellent or good for the vegetation sub-index (Appendix B, Table 47).

Statewide – Vegetation

Figure 16. The proportion of wetland extent in each condition score class across Victoria for the vegetation sub-index.

While the majority of wetland area scored excellent or good for the vegetation sub-index, there were some regional differences (Table 13). Over 80% of the wetland area in the Goulburn-Broken and 75% of the wetland area in North East scored excellent for the vegetation sub-index. At the other end of the scale over a quarter of the wetland area in the Corangamite region scored poor or very poor for vegetation. Noting that the VWCA vegetation sub-index assesses departure in vegetation condition from a baseline derived from the satellite record (beginning in the 1980s), not deviation from an unimpacted sate.

Table 13. The percentage of wetland extent in each Region in each condition class for the biota sub-index. The extent is the combined extent of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

Region	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Corangamite	52718	2473	45	17	16	21	4
East Gippsland	8843	1360	59	24	11	5	0
Goulburn-Broken	66194	4228	81	9	7	3	1
Glenelg-Hopkins	116356	7866	45	27	16	12	6
Mallee	37775	1600	43	40	11	6	0
North Central	99799	2603	59	22	17	2	1
North East	14156	3388	76	16	7	2	0
Port Phillip and Western Port	5041	1813	68	15	9	8	1
Wimmera	61082	3484	68	17	10	5	4
West Gippsland	25657	3642	46	6	38	9	0

4 Region-specific information

4.1 Corangamite

The Corangamite region covers coastal extents, parts of the Port Phillip Bay embayment and the inland western volcanic plains. These landscapes support a broad diversity of wetlands with around 2500 wetlands covering over 75,000 ha (6% of the region). These wetlands are distributed among the four river basins that occur in the Corangamite Region: Barwon River, Corangamite, Moorabool River and Otway Coast basins.

Within the Corangamite basin is Lake Corangamite, Australia's largest permanent saline lake, which has a surface extent of over 26,000 hectares, representing more than one third of the wetland extent in the Region. For this reason, Lake Corangamite has not been included in extent average scores.

The Corangamite Region contains two wetlands of international importance, the Western District Lakes Ramsar Site and part of the Port Phillip (Western Shoreline) and Bellarine Peninsula Ramsar Site. These two systems comprise vastly different wetland types and support very different species and communities. The Western District Lakes Ramsar Site comprises nine lakes in the Corangamite catchment which support a diversity and abundance of waterbirds, particularly Australian shorebirds feeding in the shallow productive waters of the large lakes. The site supports several Environment Protection and Biodiversity Conservation Act 1999 (EPBC) listed threatened wetland species including salt tussock grass (*Poa sallacustris*), spiny peppercress (*Lepidium aschersonii*) and curlew sandpiper (*Calidris ferruginea*). The lakes and wetlands of the western region, that lie outside the Ramsar site are also important habitat for a diversity of species and home to the endemic Corangamite water skink (*Eulamprus tympanum marnieae*).The portion of the Port Phillip Bay Ramsar Site within the Corangamite Region includes the Lake Connewarre Complex, which comprises saline and freshwater marshes and lakes supporting a diversity of flora and fauna including the threatened orange-bellied parrots (*Neophema chrysogaster*) on the mainland.

4.1.1 Corangamite Region Scores

The 2025 Victorian Wetland Condition Assessment found that just 4% of inland, natural wetland extent in Corangamite region was in excellent or good condition, with over half wetland extent categorised as being in poor or very poor condition (Figure 17). This pattern of small proportions of wetland extent in good and excellent condition was similar in the Barwon and Lake Corangamite Basins, which comprise the majority of wetland extent in the region (Table 14). The percentage of wetlands in good and moderate condition was higher in the part of the Moorabool Basin in the Corangamite Region with only 21% of wetland extent in this river basin in poor or very poor condition. Wetland condition was, on average, better in the Otway Basin, reflecting the lower intensity land use and higher native vegetation cover.

> In the Corangamite Region, 1% of wetland extent was in excellent condition, 3% was in good condition, 38% in moderate condition 38% in poor condition and 19% in very poor condition.

Around 37% of wetlands in the Corangamite region are on public land. The percentage of wetland extent in good or excellent condition was low for both public and private land (Table 15), but a higher percent of wetlands was in poor or very poor condition on private land. This pattern of similar percentages of wetland extent in good or excellent condition on public and private land contrasts with patterns observed over much of the rest of the state, where the condition of wetlands on public land was generally in much better condition than those on private property. This may reflect the nature of conservation reserves in the western plains of the Corangamite Region, where the boundary of reserves often follows the high-water mark of the lakes, meaning surrounding landowners may graze areas of the lakes seasonally, with little or no native vegetation between wetlands and surrounding agricultural land uses. The Corangamite Catchment area has many wetlands on public land that are surrounded directly by agricultural land, as opposed to other regions where most public wetlands are within vegetated nature reserves. The land use component of the VWCA, therefore strongly influences overall condition results in this region (see section 2.3 VWCA Score calculation).

Overall condition

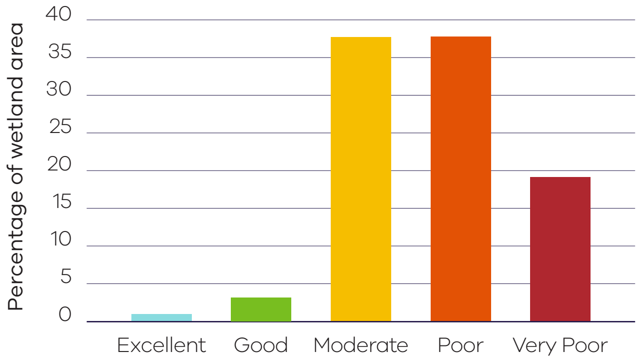


Figure 17. The percentage of wetland extent in each overall condition score class in the Corangamite region. The extent is the combined extent of mapped, inland wetlands that are not classified as dams (excluding Lake Corangamite).

Table 14. The percentage of wetland extent in each overall condition score class for River Basins in the Corangamite region. The extent is the combined extent of mapped, inland wetlands that are not classified as dams (excluding Lake Corangamite). "No." is the number of wetlands assessed.

River Basin	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Barwon River	13986	779	<1	5	25	35	34
Lake Corangamite	34720	1197	<1	1	45	39	15
Moorabool River	1499	183	1	32	46	19	2
Otway Coast	2952	308	16	14	35	25	9

Table 15. The percentage of wetland extent in each overall condition score class for wetlands on public and private land in the Corangamite region. The extent is the combined extent of mapped, inland wetlands that are not classified as dams, excluding Lake Corangamite. "No." equals the number of wetlands assessed.

	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Private	33532	2314	<1	5	19	47	29
Public	19739	158	2	2	74	19	3

Wetland landscape profiles were identified for the IWC and divide the state into regions based on elevation, rainfall and geomorphology (see Appendix A). These have been used in this assessment to represent area-weighted average wetland condition spatially. In the Corangamite Region, average wetland condition across most landscape profiles was poor to moderate (Figure 18). The lower montane extents of the Otway Basin and the adjacent near coastal extents were, on average, in good condition. There are patches of low sandy heath, which were, on average in excellent condition and this was largely due to wetlands in forested conservation reserves.

The wetlands in the lowland grassy plains of the western district were, on average, in poor to very poor condition. There was also a small extent of lowland sandy heath in the west of the Otway Basin in very poor condition, which comprised a number of very small temporary freshwater swamps with increasing amounts of bare soil, poor land use scores and moderate to poor vegetation condition.

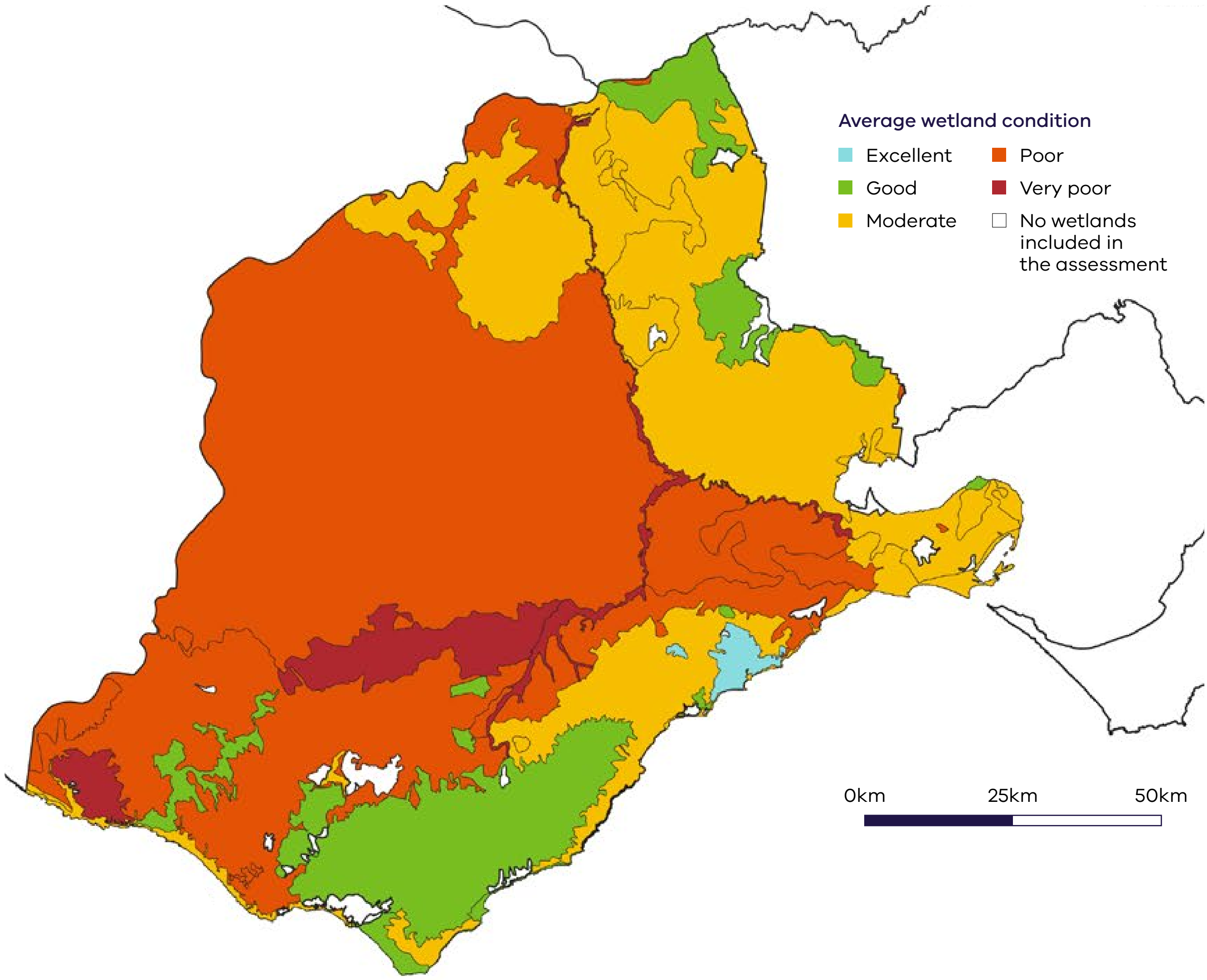


Figure 18. Area-weighted wetland condition for Victorian Wetland Landscape Profiles in the Corangamite Region.

Table 16. Area-weighted average condition scores based on VWI wetland type in the Corangamite Catchment Region. Sub-indices are scored out of 10 and the total score is out of a maximum possible of 50. The four hydrological metrics are shown separately: Magnitude of inundation, duration of inundation, frequency of inundation and the proportion of time a wetland is dry. These are combined into a single overall hydrological score before the final total scores are calculated. Red = very poor, orange = poor, yellow = good, green = very good, blue = excellent

			Hydrology metrics								
Wetland type	Extent (ha)	No.	Magnitude	Duration	Frequency	Dry Fraction	Average Hydro.	Soil	Vegetation	Land Use	Total score
Permanent freshwater lake	6484	53	6	5	9	8	7	9	8	3	29
Permanent freshwater marsh or meadow	101	12	8	7	8	9	8	8	7	5	33
Permanent freshwater swamp	69	26	8	7	9	8	8	6	9	6	34
Permanent paperbark swamp	46	10	8	9	9	8	9	8	8	7	38
Permanent saline lake	13622	35	5	4	4	9	6	8	9	3	27
Permanent saline wetland	963	4	4	4	6	6	5	8	10	6	32
Permanent salt marsh	119	7	6	6	7	8	7	5	10	4	27
Permanent salt marsh	119	7	6	6	7	8	7	5	10	4	27
Permanent shallow wetland/claypan	24	6	9	7	9	9	9	9	8	3	31
Permanent shrub swamp	142	4	8	8	10	8	8	7	10	6	37
Permanent tall marsh	12	1	6	4	10	10	8	4	10	8	32
Temporary freshwater lake	13431	452	8	8	8	8	8	6	6	3	24
Temporary freshwater marsh or meadow	6286	565	7	7	8	9	8	6	7	3	26
Temporary freshwater swamp	2590	504	8	8	8	8	8	6	7	4	27
Temporary paperbark swamp	422	47	6	6	7	8	7	5	6	3	23
Temporary river red gum swamp	2	2	9	10	10	7	9	7	10	3	31
Temporary saline lake	2161	128	6	5	6	9	7	5	7	4	26
Temporary saline swamp	234	17	5	5	7	8	6	7	9	5	32
Temporary salt marsh	2458	76	5	5	6	9	6	5	7	4	24
Temporary shallow wetland/claypan	3798	506	7	8	8	8	8	6	6	3	24
Temporary shrub swamp	293	16	8	7	10	8	8	7	10	10	41
Temporary Tall Marsh	14	1	8	8	10	10	9	6	10	8	38

4.1.2 Hydrology

The majority of wetlands in the Corangamite Region have had some amount of modification to their hydrological regimes since the 1980s (Figure 19). There are a higher percentage of wetlands with decreased duration of inundation. This is reflected in the assessment of wetland types in the Corangamite Region (Table 16), where particularly saline wetland types (permanent and temporary) have, on average decreased magnitudes, durations and / or frequencies of inundation. The wetland type averages are heavily influenced by large wetlands, particularly in the western district such as Lakes Murdeduke, Colongulac and Gnarpurt.

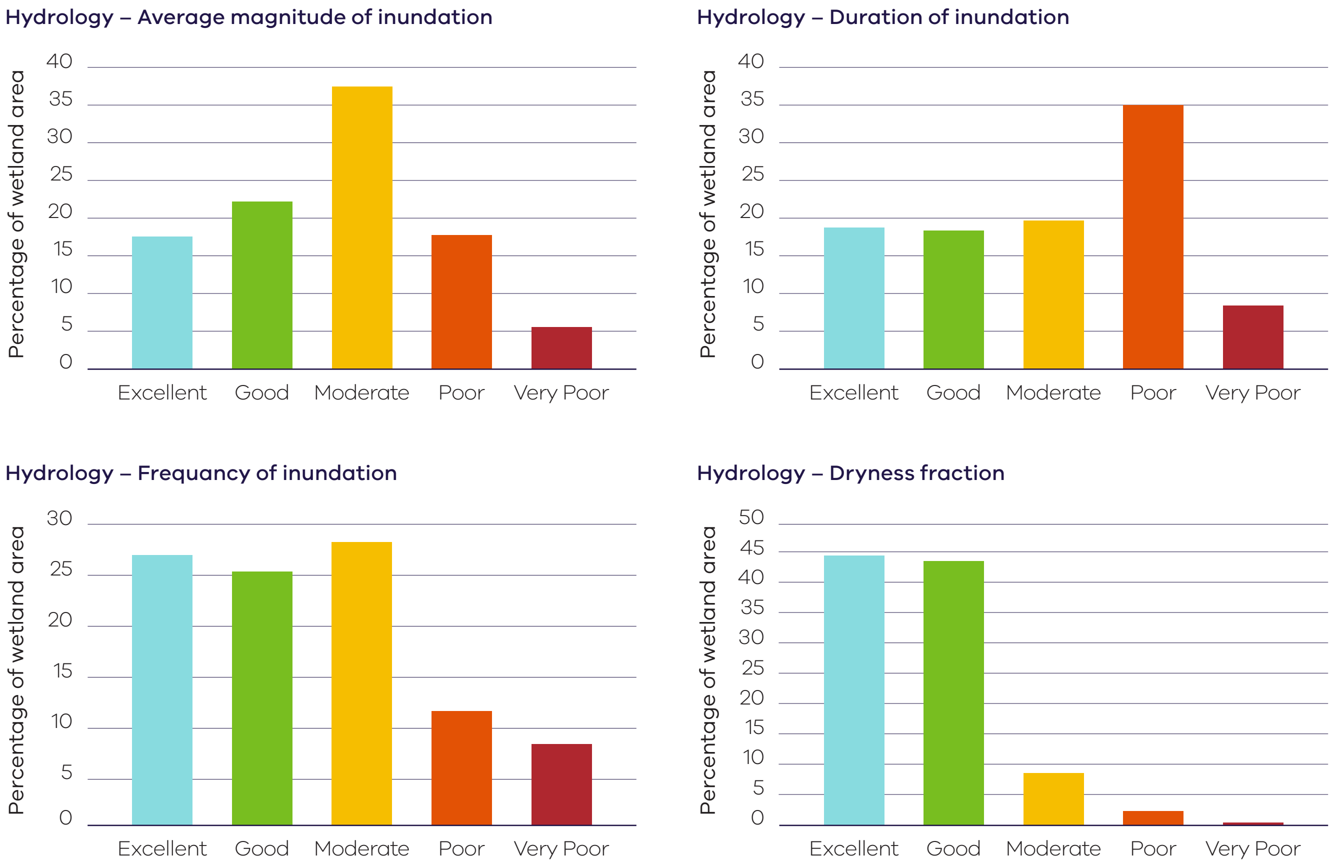


Figure 19. The percentage of wetland extent in each condition score class in the Corangamite region for average magnitude of inundation (top left) and duration of inundation (top right), frequency of inundation (bottom left) and proportion of time a wetland is dry (bottom right).

4.1.3 Soils

Around half of the wetland extent in the Corangamite region scored excellent or good for soils, indicating only small changes in the extent of exposed soil since the 1980s (Figure 20). A number of saltmarsh wetlands and saline lakes scored poor or very poor for this sub-index, particularly in the Barwon and Corangamite Basins. On average, temporary wetland types scored lower than permanent wetlands for this indicator (Table 16).

Soil

Figure 20. The percentage of wetland extent in each condition score class in the Corangamite Region for the soil sub-index.

4.1.4 Vegetation

The condition of vegetation varied from very poor to excellent among wetlands of the Corangamite region, however around two-thirds of wetland extent had good or excellent vegetation. Vegetation was in excellent condition across 45% of wetland extent and good at 17% (Figure 21). The majority of the large lakes in the western district, however, that account for a significant proportion of total wetland extent, in the region had very little vegetation detected within the wetland boundary (i.e. fringing vegetation) making it difficult to detect change over time with the relatively coarse spatial resolution of Landsat (30 metre pixels). Finer scale vegetation and habitat mapping approaches would be needed to detect more subtle patterns in wetland vegetation. The 21% of wetland extent in poor or very poor condition included representatives of all wetland types, but predominantly temporary freshwater wetlands in the Lake Corangamite and Barwon Basins.

Vegetation

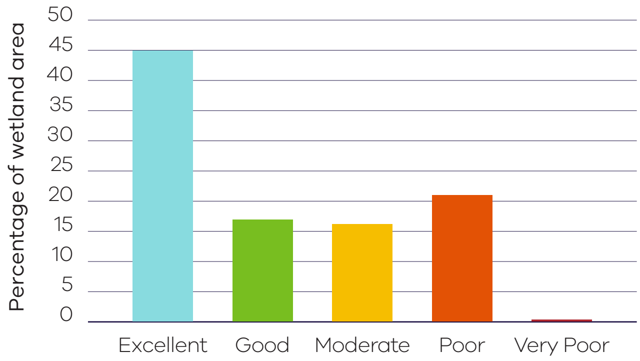


Figure 21. The percentage of wetland extent in each condition score class in the Corangamite Region for the vegetation sub-index.

4.1.5 Land use

The Corangamite Region is dominated by agriculture, which covers around 60% of the entire region, particularly through the Volcanic Plain. The majority of the wetlands in the Barwon and Corangamite Basins are within agricultural landscapes (Figure 22). Just 1% of wetland extent is surrounded by natural land uses, scoring "excellent" (Figure 23). There were around 8% of wetland extent that scored moderate for land use, 35% that scored poor and 55% that score very poor. This reflects the agricultural land use of the region and the fact that even wetlands that are in conservation reserves are often surrounded by moderate to high intensity land uses. Land use may impact wetlands through nutrient load caused by run off, as well as water extractions impacting drying regimes. Therefore, land management practices at a finer scale are key to the health of local wetlands.

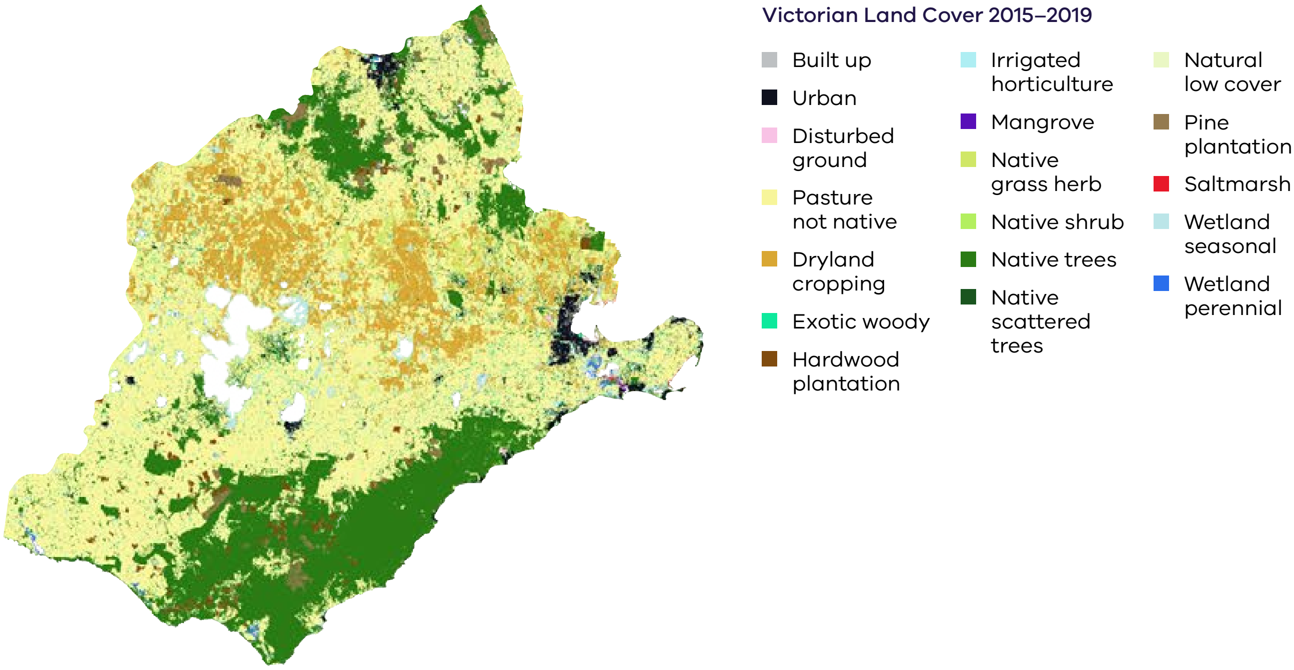


Figure 22. Victorian Land Cover Time Series (2015–2019) for the Corangamite Region.

Figure 23. The proportion of wetland extent in each condition score class in the Corangamite Region for the land use sub-index.

4.2 East Gippsland

The East Gippsland region supports a diversity of wetlands with over 1300 inland wetlands covering an area of approximately 8,800 hectares. This includes parts of the Gippsland Lakes Ramsar site, noting that the large coastal lagoons of Lakes Victoria and King are not included in this assessment of wetland condition, due to their permanent connection to the sea, but it does include the fringing wetlands of the Ramsar site such as Macleod Morass. The wetlands of East Gippsland are distributed among four river basins: Far East Gippsland basin, Mitchell River, Snowy River and Tambo River basins.

Although 20 of the 27 inland wetland types defined in the Victorian Wetland Inventory are represented in East Gippsland, just three types have extents that total greater than 1000 hectares, temporary freshwater marsh or meadow such as Ewing's Morass, temporary shrub swamp, typically in low land areas, and peatlands of the alpine region.

East Gippsland is one of the few places on mainland Australia where continuity of natural ecosystems – from the alps to the sea – still exists and, East Gippsland has the largest proportion of wetlands on public land (44%) of any Region. The river valleys of much of East Gippsland are steep and incised, with small areas of floodplain. As a consequence, many of the wetlands within the region are associated with the alpine areas (e.g. alpine peatlands and associated fens). The peatlands of the alpine region are rare in Australia and restricted largely to the southeast corner of the mainland and Tasmania. The peatlands of East Gippsland are permanently wet sites that contain at least one species of Sphagnum in areas above 1000 metres. They perform important hydrological functions, filtering nutrients and sediments and maintaining good water quality in streams and groundwater. They support a diversity of aquatic flora and fauna including threatened species such as the Victorian listed vulnerable alpine pennywort (*Schizeilema fragoseum*), the *Flora and Fauna Guarantee Act 1988* (FFG Act) listed alpine bog skink (*Pseudemoia cryodroma*), alpine water skink (*Eulamprus kosciuskoi*) and alpine spiny crayfish (*Euastacus crassus*) as well as the nationally (EPBC listed) vulnerable alpine tree frog (*Litoria verreauxii alpina*). Significant alpine wetlands in East Gippsland include the nationally important Nuniong Plateau Peatlands and the FFG threatened ecological community of the Montane Swamp Complex, which comprises seven small sites (total of 44 hectares) on the tributaries of the western headwaters of the Tambo River.

The East Gippsland region also includes Seasonal Herbaceous Wetlands of the Temperate Lowlands – a critically endangered ecological community under the Environmental Protection and Biodiversity Conservation Act (EPBC). Remnants of this ecological community remain in the Gippsland Red Gum Plains which extend from near Traralgon and the Latrobe Valley in the west, to Bairnsdale in the east. The plains have been extensively modified for agriculture, threatening the remnant wetland ecological communities (EGCMA 2022).

Many valuable coastal wetland ecosystems are also found in East Gippsland, including the Ramsar listed Gippsland Lakes. However, these systems were not included in the VWCA which assesses inland, natural wetlands (see section 2.2.2).

4.2.1 East Gippsland Region Scores

The 2025 Victorian Wetland Condition Assessment found that three quarters of inland, natural wetland area in East Gippsland was in excellent or good condition (Figure 24). Over half of the wetland area in the Far East Gippsland, Snowy and Tambo Basins were in excellent condition, with 10 – 30% in good condition and 9 – 27% in moderate condition. In the Tambo Basin, 5% of wetland area was in poor condition. In the Mitchell River Basin 28% of wetland area was in excellent condition, 24% in good condition and around half in moderate condition (Table 17). The higher proportion of wetlands in moderate condition in the Mitchell Basin reflects the higher intensity land use, increased water extraction and lower proportion of land in conservation reserves.

In the East Gippsland Region, 48% of wetland area was in excellent condition, 28% was in good condition, 23% in moderate condition and 1% in poor condition.

Around 60 percent of the inland natural wetland area in the East Gippsland Region is on public land, in conservation reserves or managed forests. The percent of wetland area in excellent condition was higher for wetlands on public land (65%) compared to private land (21%). Both land tenures had a high percentage of wetland area in good or excellent condition compared to other Regions. There were more wetlands in poor condition on private land and < 1% of wetland area in very poor condition in both land tenure classes (Table 18).

Overall condition

Figure 24. The percentage of wetland area in each overall condition score class in the East Gippsland region. The area is the combined area of mapped, inland wetlands that are not classified as dams.

Table 17. The percentage of wetland area in each overall condition score class for River Basins in the East Gippsland region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

River Basin	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Far East Gippsland	1701	171	52	31	17	<1	0
Mitchell River	2790	511	28	24	45	3	<1
Snowy River	3002	398	68	23	9	<1	0
Tambo River	708	212	55	13	27	5	<1

Table 18. The percentage of wetland area in each overall condition score class for wetlands on public and private land in the East Gippsland region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Private	3462	421	21	52	24	4	<1
Public	5381	939	65	13	22	<1	0

Wetland landscape profiles were identified for the IWC and divide the state into regions based on elevation, rainfall and geomorphology. These have been used in this assessment to represent area-weighted average wetland condition spatially. The majority had wetlands in the East Gippsland Region that were, on average, in excellent or good condition (Figure 25). Exceptions were wetlands within "lowland riparian floodplains" of the Cann, Snowy, Mitchell and Tambo rivers; and the "drier western hills, tablelands and inland slopes" of the upper Tambo, where average wetland condition was moderate. A small area along the Tambo had an average condition rating of poor. This wetland landscape had very small number and extent of wetlands (< 40 hectares) that were largely in poor to moderate condition, likely reflecting agricultural land use on the Tambo River floodplain and the subsequent low scores for the land use sub-index.

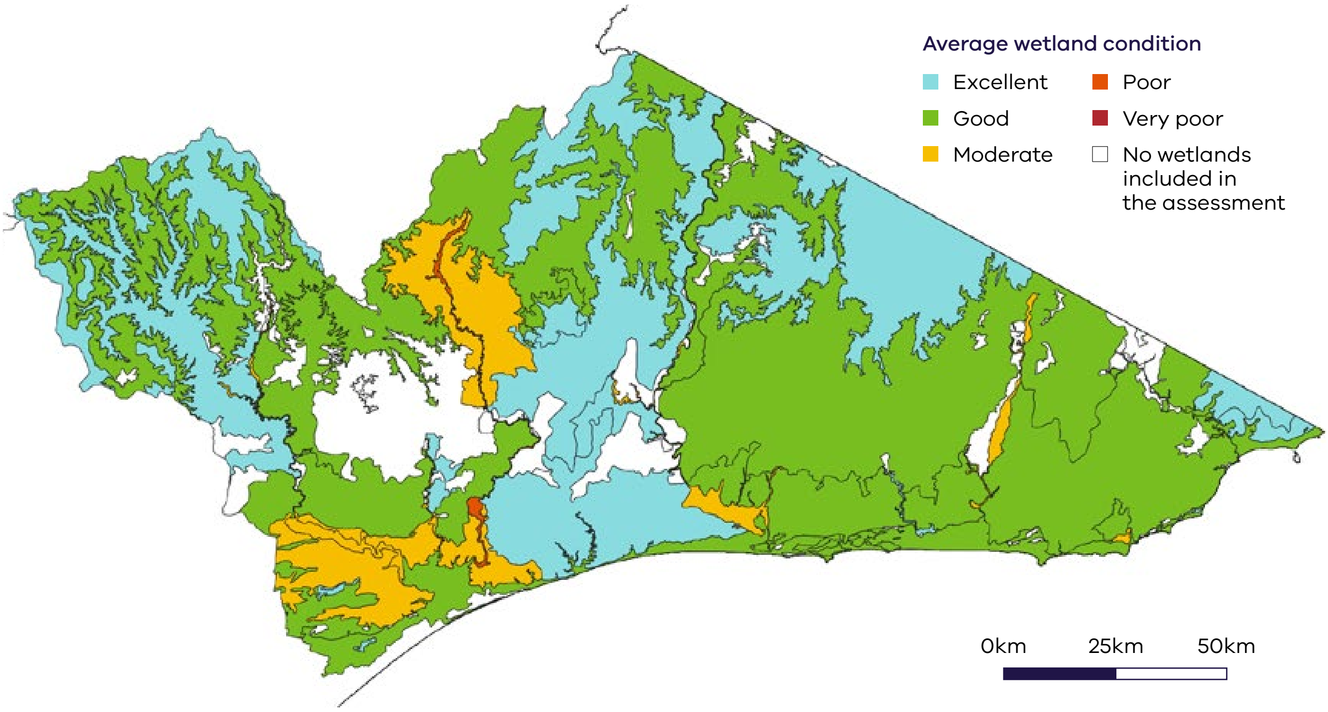


Figure 25. Area weighted wetland condition for Victorian Wetland Landscape Profiles. Note that although Lakes Victoria and King form part of the near coastal wetland landscape profiles, no marine or estuarine wetlands were included in the assessment of wetland condition, the scores for this unit reflect the condition of smaller inland wetlands within the landscape profile. Clear areas are landscape profiles that did not have any wetlands included in the VWCA.

Credit: Sean Phillipson EGCMA

Table 19. Area-weighted average condition scores based on VWI wetland type in the East Gippsland Region. Sub-indices are scored out of 10 and the total score is out of a maximum possible of 50. The four hydrological metrics are shown separately: Magnitude of inundation, duration of inundation, frequency of inundation and the proportion of time a wetland is dry. These are combined into a single overall hydrological score before the final total scores are calculated. Red = very poor, orange = poor, yellow = good, green = very good, blue = excellent

			Hydrology metrics								
Wetland type	Area (ha)	No.	Magnitude	Duration	Frequency	Dry Fraction	Average Hydro.	Soil	Vegetation	Land Use	Total score
Peatlands	1188	739	8	9	9	8	9	9	10	10	45
Permanent freshwater lake	93	8	8	8	8	8	8	9	9	6	38
Permanent freshwater marsh or meadow	4	1	8	10	10	6	9	10	6	2	27
Permanent freshwater swamp	450	44	8	5	6	8	7	9	10	10	42
Permanent saline lake	35	2	10	8	8	7	8	10	6	5	33
Permanent saline wetland	188	5	8	10	9	5	8	10	9	8	41
Permanent salt marsh	614	8	8	10	10	4	8	10	7	10	40
Permanent shallow wetland/claypan	721	14	8	9	9	6	8	10	8	7	38
Permanent shrub swamp	632	26	6	5	7	5	5	10	10	5	33
Permanent tall marsh	11	3	7	8	8	5	7	8	7	7	35
Temporary freshwater lake	392	30	9	9	9	8	9	10	10	5	37
Temporary freshwater marsh or meadow	1719	56	10	10	8	10	9	10	8	9	44
Temporary freshwater swamp	846	159	8	8	8	8	8	9	9	7	41
Temporary paperbark swamp	88	7	8	8	8	10	9	8	10	2	30
Temporary saline lake	1	1	10	10	10	6	9	10	10	10	48
Temporary saline swamp	126	6	8	8	8	8	8	9	10	5	36
Temporary salt marsh	364	12	8	9	6	8	8	10	9	6	38
Temporary shallow wetland/claypan	303	113	8	8	8	9	8	9	8	5	35
Temporary shrub swamp	1005	124	9	9	8	9	9	8	7	9	40
Temporary Tall Marsh	63	2	6	6	10	10	8	6	10	10	39

4.2.2 Hydrology

The majority of wetland area in the East Gippsland Region had little modification to wetland hydrological regimes with over three quarters of wetland area classified as excellent or good with respect to the magnitude, duration and frequency of inundation (Figure 26). This is reflected in the assessment of wetland types in the East Gippsland Region (Table 19), where most wetland types were assessed as having good hydrology. There were declines, on average, in the duration and frequency of inundation in permanent freshwater swamps and shrub swamps.

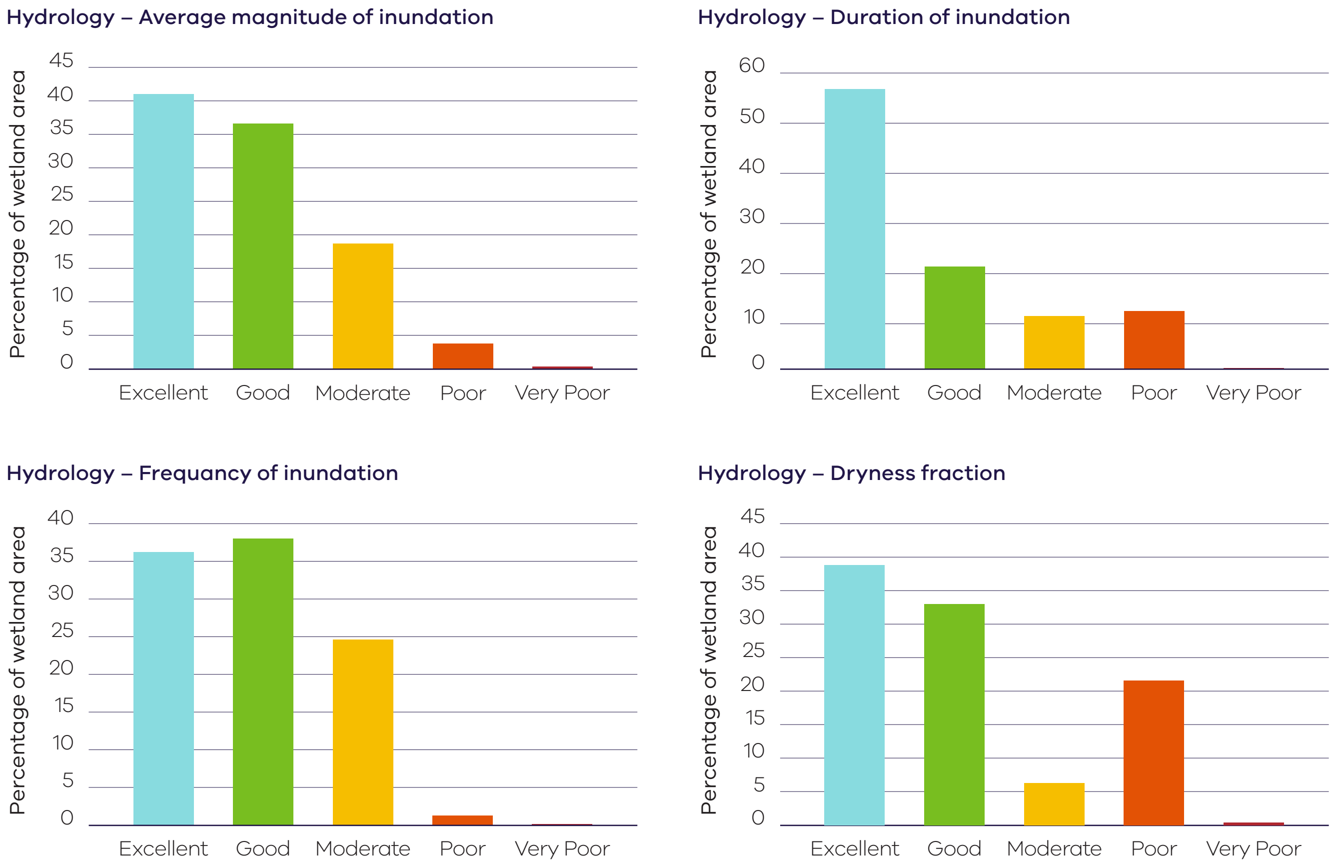


Figure 26. The percentage of wetland area in each condition score class in the East Gippsland region for average magnitude of inundation (top left) and duration of inundation (top right), frequency of inundation (bottom left) and proportion of time a wetland is dry (bottom right).

4.2.3 Soils

The majority of wetland area in the East Gippsland Region scored excellent for soils, indicating no change in exposed soil from the late 1980s to current (Figure 27). The 8% of wetland area that scored "moderate" and / or poor were small temporary vegetated swamps on the lower Mitchell and Tambo Rivers and a small area of peatlands in the upper Tambo and Snowy River Basins.

Figure 27. The percentage of wetland area in each condition score class in the East Gippsland region for the soil sub-index.

4.2.2 Vegetation

The condition of vegetation varied from very poor to excellent among wetlands of the East Gippsland region, however the vast majority of wetland area had good or excellent vegetation. Vegetation was in excellent condition across 59% of wetland area and good at 24% (Figure 28). This perhaps reflects the low level of threat to much of the wetlands in the region, with a high proportion of wetlands on public land, no large-scale water resource use and in areas that are largely still covered in native vegetation. The 16% of wetland area in moderate or poor condition are largely small, temporary, freshwater wetlands in the lowlands and near coastal areas of the Mitchell and Tambo Rivers.

Figure 28. The percentage of wetland area in each condition score class in the East Gippsland region for the vegetation sub-index.

4.2.5 Land use

Wetlands in the East Gippsland Region are predominantly in low intensity land use surroundings with a high proportion of native forest and natural vegetation (Figure 29). Sixty-four percent of wetlands are surrounded by natural land uses, scoring "excellent" (Figure 30). There were around 7% of wetland areas that scored moderate for land use, 20% that scored poor and 5% that score very poor. These low scoring wetland areas were all in lowland regions and predominantly at the bottom of the Mitchell River, where there are urban areas around Bairnsdale as well as horticulture and cropping. Wetland types in these higher intensity land uses were commonly Permanent saline wetlands, Permanent and temporary shallow wetland/claypans, and Temporary freshwater lakes. Macleod Morass, which is located within the town of Bairnsdale fell into the poor class for the land use sub-index.

Victorian Land Cover 2015–2019

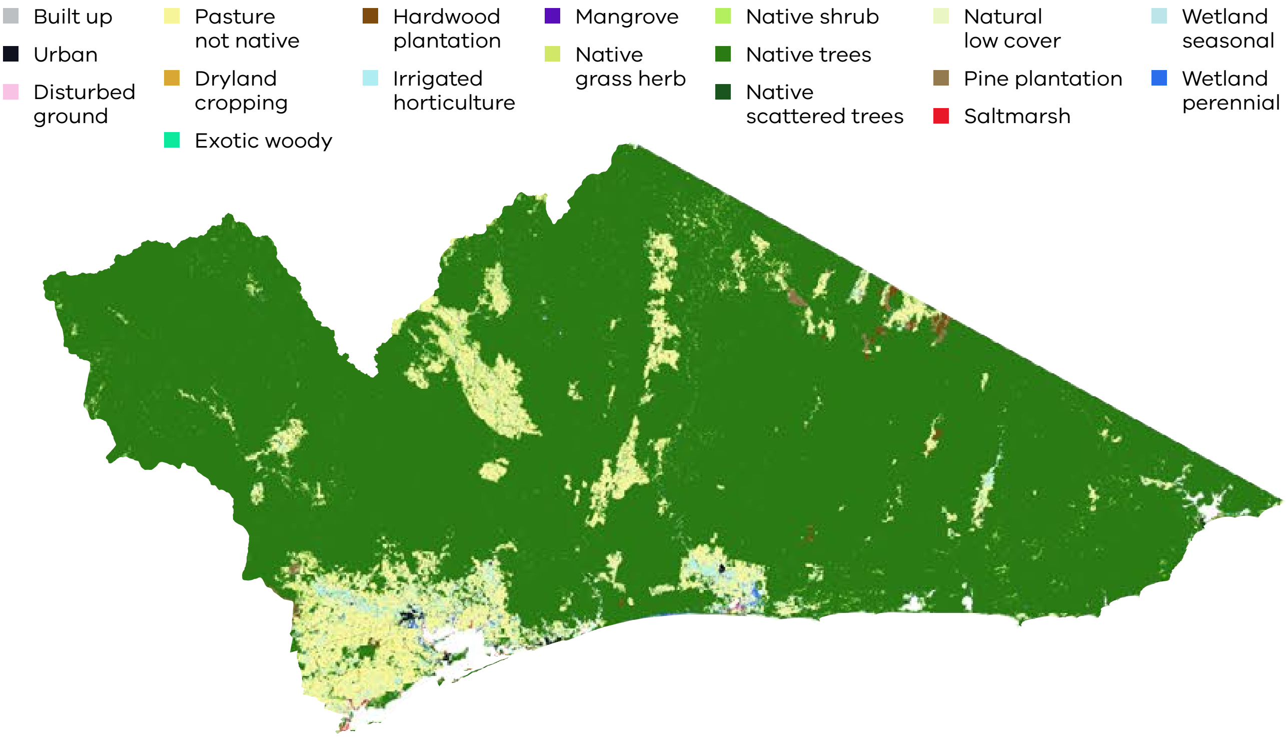


Figure 29. Victorian Land Cover Time Series (2015–2019) for East Gippsland.

Land Use

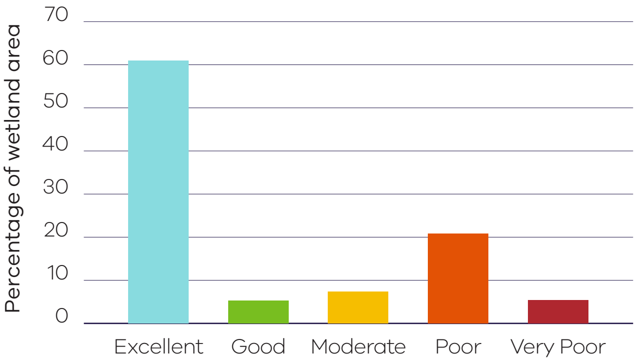


Figure 30. The percentage of wetland area in each condition score class in the East Gippsland Region for the land use sub-index.

4.3 Glenelg-Hopkins

The Glenelg-Hopkins region contains over 7800 inland, natural wetlands covering around 116,000 hectares, representing almost a quarter of Victoria's mapped wetlands (by quantity and area). While most of the wetlands are fresh (89% of wetland area) and temporary (86% of wetland area) there are a number of permanent wetlands such as the Bridgewater Lakes and saline systems like Lakes Goldsmith, Wongan and Bookar. The wetlands of the region are distributed among four river basins: Glenelg River, Hopkins River, Millicent Coast, and Portland Coast basins.

The region includes the Glenelg Estuary and Discovery Bay Ramsar Site, which in addition to coastal and estuarine wetlands, contains significant areas of inland freshwater wetlands included in this assessment (e.g. Long Swamp, Bridgewater Lakes). Lake Bookar, which is part of the Western District Lakes Ramsar site is also within the Glenelg-Hopkins region. In addition, there are 16 wetlands on the Directory of Important Wetlands of Australia including several wetland complexes such as the Mundi-Selkirk Wetlands, Lake Linlithgow Wetlands and the Woorndoo-Hopkins Wetlands. Three nationally listed threatened ecological communities occur in wetlands in the region:

- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains.
- Subtropical and Temperate Coastal Saltmarsh.
- Karst Springs and Associated Alkaline Fens of the Naracoorte Coastal Plain.

The wetlands of the Glenelg-Hopkins region support a diversity of inundation dependant plants and animals. The wetlands of the region are important for supporting populations of several nationally (EPBC listed) listed species including Australasian bittern (*Botaurus poiciloptilus*), growling grass frog (*Litoria raniformis*), Yarra pygmy perch (*Nannoperca obscura*), maroon leek-orchid (*Prasophyllum frenchii*), swamp greenhood (*Pterostylis tenuissima*) and ancient greenling (*Hemiphlebia mirabilis*).

4.3.1 Glenelg-Hopkins Region Scores

The 2025 Victorian Wetland Condition Assessment found that 20% of natural inland wetland area in the Glenelg-Hopkins region was in excellent or good condition, one third was in moderate condition and a further third in poor condition, while 10% of wetland area was in very poor condition (Figure 31). There is a big difference in wetland condition between the three major river basins (Table 20). The Hopkins Basin contains around 60% of the total area of inland natural wetlands in the region, with 4% of wetland area in good condition, 37% in moderate condition and over half the wetland area in poor or very poor condition. The Portland Coast and Millicent Coast basins had a higher proportion of wetlands in excellent (4% and 9%, respectively) and good (15% and 11%, respectively) condition, but over 40% in poor or very poor condition. In contrast the Glenelg Basin has a much higher proportion of wetland area in excellent (37%) and good (16%) condition and just 21% in poor or very poor condition. This reflects the lower intensity land use and associated pressures in the Glenelg River Basin compared to the Hopkins and Portland Coast.

In the Glenelg-Hopkins Region, 12% of wetland area was in excellent condition, 8% was in good condition, 33% in moderate condition 34% in poor condition and 11% in very poor condition.

Only 10% of mapped wetlands and 20% of wetland area is on public land in the Glenelg-Hopkins region. These wetlands, largely in conservation reserves and state forest are, on average, in better condition than those on private property (Table 21). Half the wetland area on public land is in excellent condition comparted to just 2% of wetland area on private property. Over half of wetlands on private property were in poor or very poor condition compared with 4% of wetlands on public land.

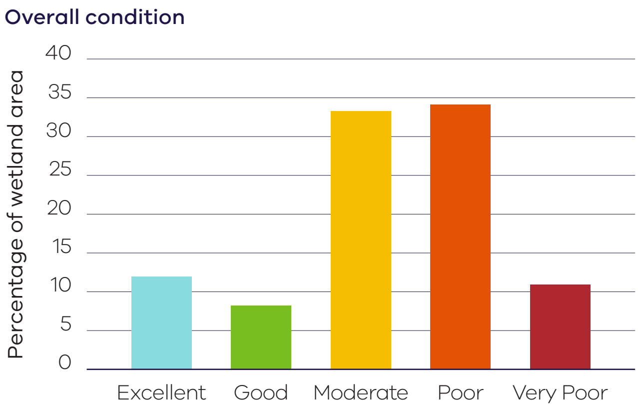


Figure 31. The percentage of wetland area in each overall condition score class in the Glenelg-Hopkins region. The area is the combined area of mapped, inland wetlands that are not classified as dams

Table 20. The percentage of wetland area in each overall condition score class for River Basins in the Glenelg-Hopkins region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

River Basin	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Glenelg River	34819	2351	37	16	26	19	2
Hopkins River	68747	3832	<1	4	37	42	15
Millicent Coast	4347	361	4	15	30	26	21
Portland Coast	8395	1292	9	11	34	35	8

Table 21. The percentage of wetland area in each overall condition score class for wetlands on public and private land in the Glenelg-Hopkins region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Private	91845	7112	2	7	32	43	15
Public	24512	754	48	12	37	3	1

Wetland landscape profiles were identified for the IWC and divide the state into regions based on elevation, rainfall and geomorphology. These have been used in this assessment to represent area-weighted average wetland condition spatially. Wetland condition scores across these landscape profiles in the Glenelg-Hopkins region ranged from excellent to poor (Figure 32). The results probably reflect river basin and catchment, rather than wetland landscapes. For example, the wetland landscapes 'near coastal', 'drier western hills and tablelands', 'lowland grassy plains' and 'lowland grassy slopes' of the Glenelg River Basin (west of the region) had on average, wetlands in excellent and good condition, while the same wetland landscape types in the east of the region were in moderate or poor condition.

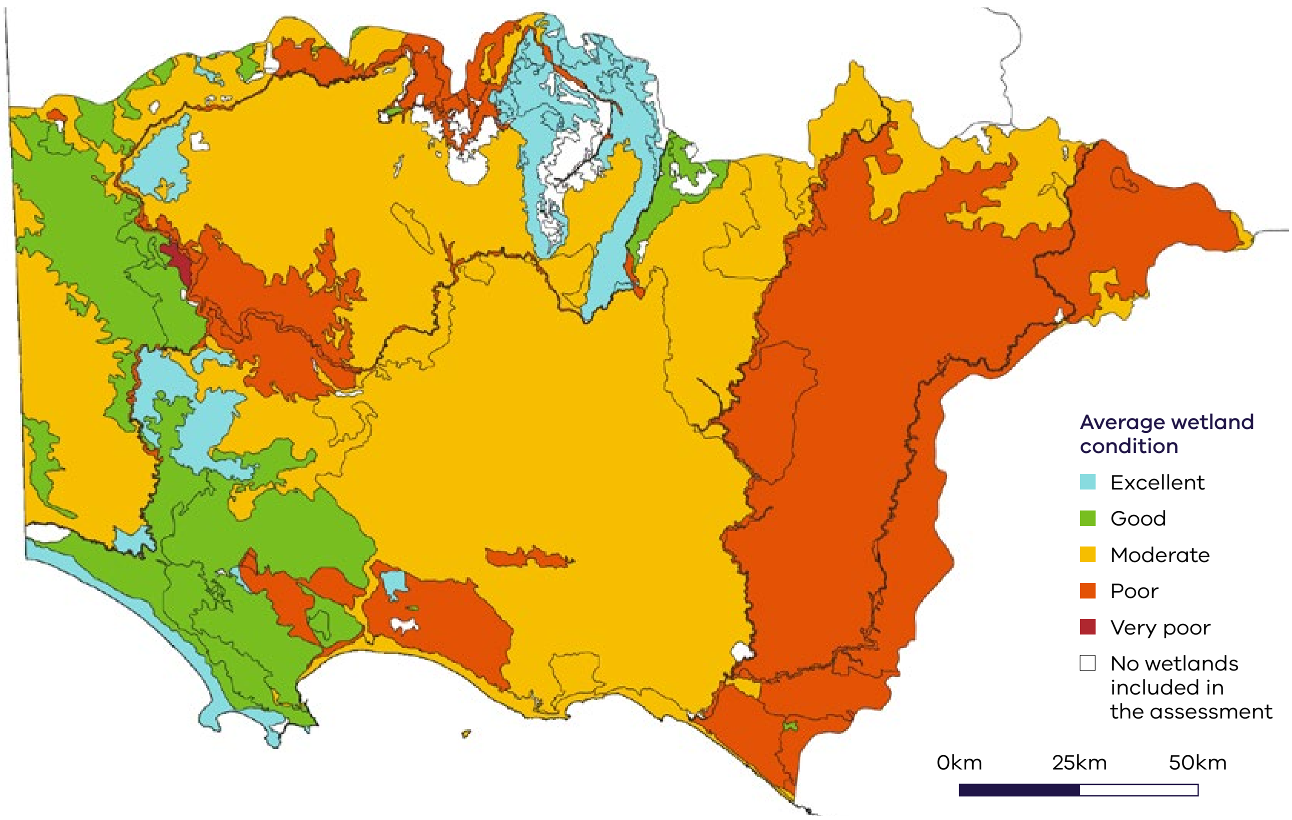


Figure 32. Area weighted wetland condition for Victorian Wetland Landscape Profiles in the Glenelg-Hopkins Region. Clear areas are landscape profiles that contained no wetlands included in the VWCA.

Table 22. Area-weighted average condition scores based on VWI wetland type in the Glenelg-Hopkins Region. Sub-indices are scored out of 10 and the total score is out of a maximum possible of 50. The four hydrological metrics are shown separately: Magnitude of inundation, duration of inundation, frequency of inundation and the proportion of time a wetland is dry. These are combined into a single overall hydrological score before the final total scores are calculated. Red = very poor, orange = poor, yellow = good, green = very good, blue = excellent

			Hydrology metrics								
Wetland type	Area (ha)	No.	Magnitude	Duration	Frequency	Dry Fraction	Average Hydro.	Soil	Vegetation	Land Use	Total score
Peatlands	40	6	5	6	7	10	7	9	10	10	42
Permanent freshwater lake	8163	115	8	7	8	10	8	10	9	3	32
Permanent freshwater marsh or meadow	919	15	8	8	10	10	9	7	10	5	33
Permanent freshwater swamp	104	24	6	8	8	6	7	8	9	5	33
Permanent paperbark swamp	228	24	9	8	9	8	8	7	9	5	32
Permanent saline lake	4629	77	6	5	6	9	6	9	9	3	29
Permanent saline wetland	108	8	6	6	7	7	7	9	8	5	33
Permanent salt marsh	144	9	7	6	9	9	8	10	8	5	35
Permanent shallow wetland/ claypan	175	13	8	10	8	8	8	10	7	4	33
Permanent shrub swamp	122	13	6	7	8	7	7	9	9	10	41
Permanent tall marsh	1	1	10	8	8	8	9	8	10	6	38
Temporary freshwater lake	30031	1085	8	8	8	8	8	6	7	3	27
Temporary freshwater marsh or meadow	30038	2661	7	8	8	8	8	6	8	4	29
Temporary freshwater swamp	5369	946	8	8	8	7	8	6	8	5	31
Temporary paperbark swamp	2933	382	8	8	9	8	8	7	9	4	31
Temporary river red gum swamp	4476	471	6	6	8	9	7	6	8	4	28
Temporary saline lake	2135	108	7	7	7	9	8	6	9	4	29
Temporary saline swamp	1465	9	6	7	9	7	7	7	8	5	33
Temporary salt marsh	1216	41	5	5	8	7	6	5	7	4	24
Temporary shallow wetland/claypan	13356	1458	8	8	8	8	8	6	7	4	28
Temporary shrub swamp	10683	396	9	9	8	7	8	10	10	9	45
Temporary Tall Marsh	20	4	7	8	9	9	8	9	9	6	38

4.3.2 Hydrology

The majority of wetlands in the Glenelg-Hopkins Region have relatively low amounts of modification to their hydrological regimes since the 1980s with over 60% of wetland area classified as excellent or good with respect to the magnitude, duration and frequency of inundation as well as the proportion of time that a wetland is dry (Figure 33) Wetlands that scored moderate, poor or very poor for hydrology included examples of all wetland types, but some types had higher impacts that others (Table 22). For example, a percentage of peatlands had reduced magnitude, duration and frequency of inundation, but proportion of time the wetland was dry was relatively unimpacted. A number of permanent saline lakes on the Victorian Volcanic Plains in the Hopkins River Basin also had reduced magnitude, duration and frequency of inundation as did temporary river red gum swamps. Several temporary freshwater swamps, particularly in the Portland Coast Basin showed increased duration and frequency of inundation. The hydrology sub-index is underpinned by data from 1988–2022. Since the end of 2022 some parts of Victoria have experienced very dry conditions (e.g., south west Victoria, including the Glenelg-Hopkins Region), with reduced rainfall and record-breaking dry spells. As such, the Hydrology sub-index scores for the Glenelg Hopkins region may underestimate levels of hydrological stress for the wetlands of this region at the time of this report (Text Box 9).

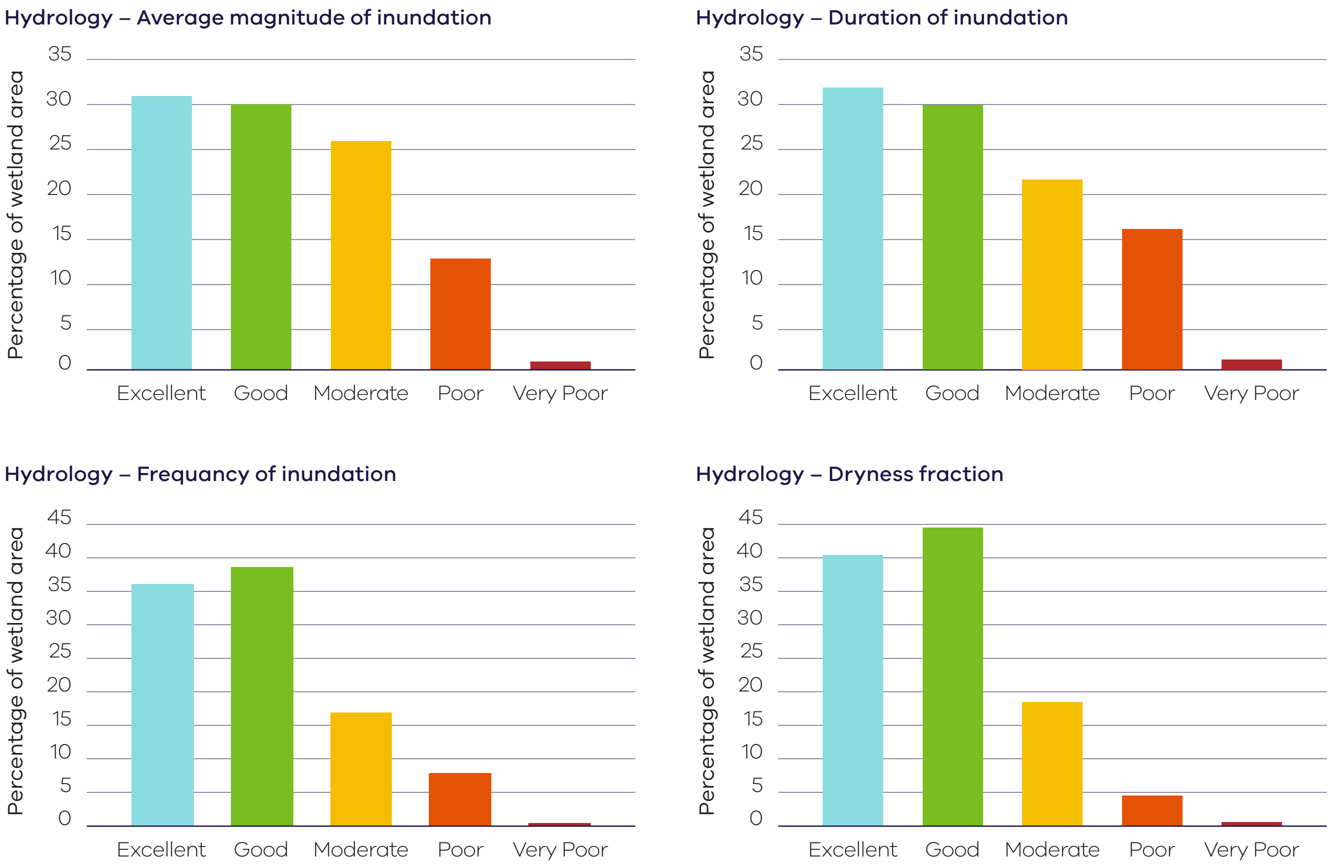


Figure 33. The percentage of wetland area in each condition score class in the Glenelg-Hopkins Region for average magnitude of inundation (top left) and duration of inundation (bottom right), frequency of inundation (top left) and proportion of time a wetland is dry (bottom right).

4.3.3 Soils

Around half of the wetland area in the Glenelg-Hopkins region scored excellent or good for soils, indicating only small changes in the area of exposed soil since the 1980s (Figure 34). Wetlands across most wetland types had areas that scored poor or very poor for this sub-index, but particularly temporary freshwater lakes and freshwater sedge/grass marsh or meadows (Table 22).

Figure 34. The percentage of wetland area in each condition score class in the Glenelg-Hopkins Region for the soil sub-index.

4.3.4 Vegetation

Vegetation was in excellent condition across 45% of wetland area and good at 27% (Figure 35). The small amount of wetland in poor and very poor condition were scattered across all regions and most wetland types.

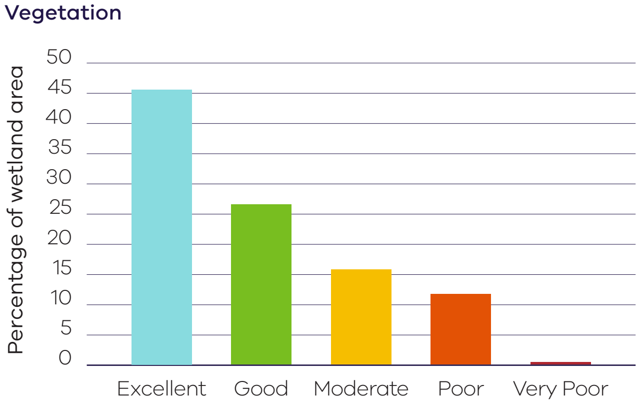


Figure 35. The percentage of wetland area in each condition score class in the Glenelg-Hopkins Region for the vegetation sub-index.

4.3.5 Land use

The Glenelg-Hopkins Region is dominated by agriculture, which covers around 80% of the entire region. In recent years there has been a shift from pasture to cropping (a higher intensity land use) and as of 2019, there were over 200,000 hectares of cropping (up from < 50,000 hectares in 1990). While the majority of wetlands are in agricultural landscapes, there are a proportion of wetlands also in conservation reserves and surrounded by native vegetation (Figure 36). Around 16% of wetlands scored "excellent" or "good" for this sub-index (Figure 37). Those wetlands that scored poor or very poor where largely in the cropping region of the Hopkins River Basin. There has been an increase in the incidence of cropping in wetlands since the 1990s, particularly in the area south west of the Grampians National Park (see Text Box 1).

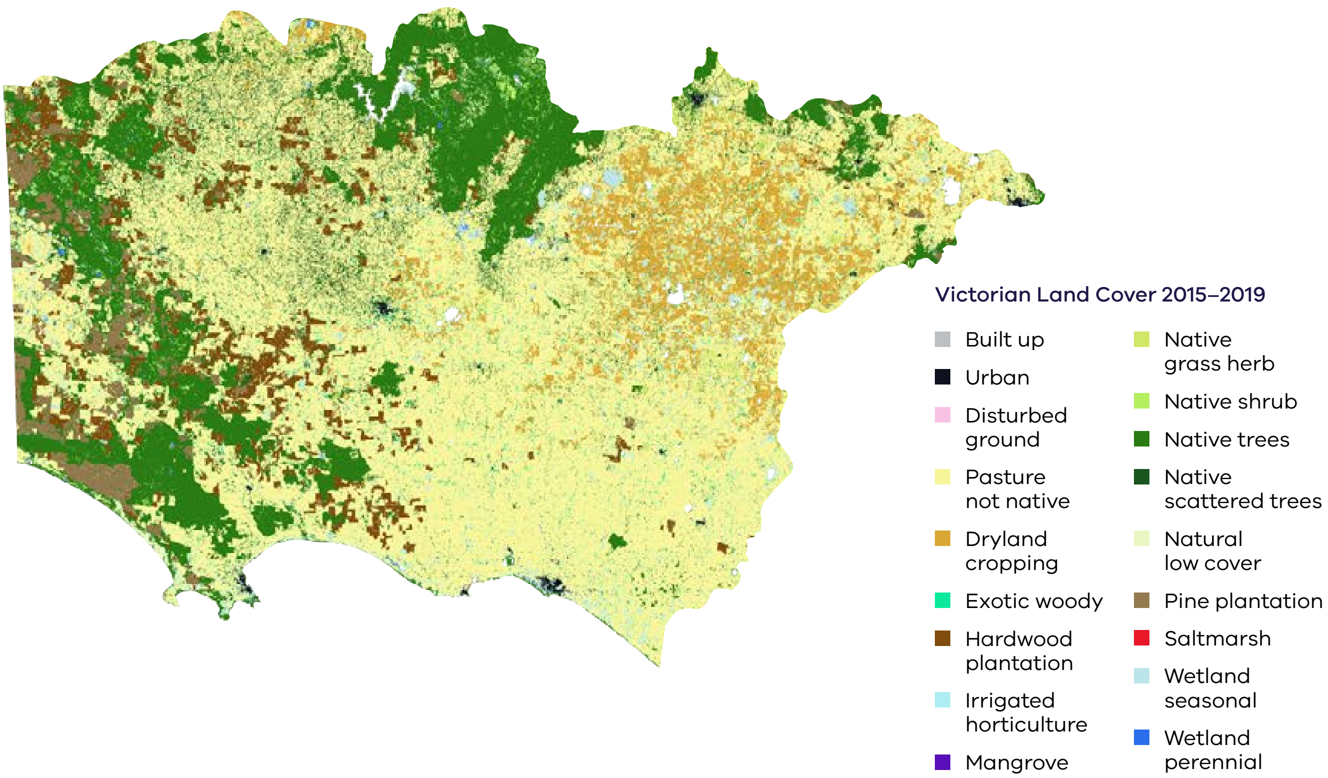


Figure 36. Victorian Land Cover Time Series (2015–2019) for the Glenelg-Hopkins Region.

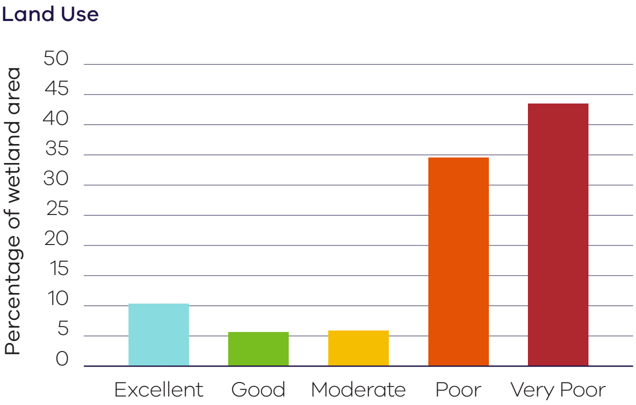


Figure 37. The percent of wetland area in each condition score class in the Glenelg-Hopkins Region for the land use sub-index.

4.4 Goulburn-Broken

The Goulburn-Broken region contains over 4000 wetlands covering around 55,000 hectares. These wetlands are distributed among the Broken River and Goulburn River Basins.

The vast majority of wetlands are freshwater (> 95%) and temporary (85%) holding water for only part of the time. There are a diversity of wetland types including peatlands in alpine areas, river red gum and lignum swamps in floodplain areas and freshwater marshes and meadows, including the EPBC listed Seasonal Herbaceous Wetlands.

The region includes the Ramsar listed Barmah Forest which comprises extensive floodplain forests, and numerous depressional floodplain wetlands. There are also several significant wetlands listed on the Directory of Important Wetlands in Australia, including Moodie Swamp, Gaynor Swamp, Kanyapella Basin, Muckatah Depression, Walenjoe Wetlands, Reedy Swamp, Loch Garry and the Central Highland Peatlands.

The wetlands of the Goulburn-Broken Region support a diversity of inundation dependant plants and animals. The wetlands of the region are important for supporting populations of several nationally listed species including Australasian bittern (Botaurus poiciloptilus), Latham's snipe (Gallinago hardwickii), Sloane's froglet (Crinia sloanei), river swamp wallaby-grass (Amphibromus fluitans), ridged water milfoil (Myriophyllum porcatum). Several wetlands in the region are provide significant breeding habitat for waterbirds including brolga (Antigone rubicunda), royal spoonbill (Platalea regia) and intermediate egret (Ardea intermedia plumifera).

4.4.1 Goulburn-Broken Region Scores

The Victorian Wetland Condition Assessment found that half of natural wetland area in Goulburn-Broken region was in excellent or good condition and around a quarter in poor or very poor condition (Figure 38). In the Broken Basin two thirds of wetland area was in excellent or good condition, and around a quarter in poor or very poor condition. In the Goulburn Basin, one quarter of wetland area was in good or excellent condition and around one third in poor or very poor condition (Table 23). The higher proportion of wetland area in excellent and good condition in the Broken Basin may reflect the large extent of mapped wetlands in the Barmah Forest National Park, which account for almost 75% of the mapped wetland area in the Broken Basin and were in largely excellent condition.

In the Goulburn-Broken Region, 38% of wetland area was in excellent condition, 12% was in good condition, 23% in moderate condition 24% in poor condition and 2% in very poor condition.

The percentage of wetland area in excellent and good condition was higher for wetlands on public land (65% and 11% respectively) compared to private land (1% and 14%). There was a corresponding higher percentage of wetland area in poor and very poor condition on private land (Table 24).

Figure 38. The percentage of wetland area in each overall condition score class in the Goulburn-Broken region. The area is the combined area of mapped, inland wetlands that are not classified as dams

Table 23. The percentage of wetland area in each overall condition score class for River Basins in the Goulburn-Broken region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

River Basin	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Broken River	39888	1087	59	8	10	21	2
Goulburn River	26121	3134	7	18	43	29	3

Table 24. The percentage of wetland area in each overall condition score class for wetlands on public and private land in the Goulburn-Broken region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Private	27492	3639	1	14	45	35	6
Public	38702	589	65	11	7	17	0

Wetland landscape profiles were identified for the IWC and divide the state into regions based on elevation, rainfall and geomorphology. These have been used in this assessment to represent area-weighted average wetland condition spatially. In the Goulburn-Broken region average wetland condition across wetland landscape profiles ranged from excellent to poor (Figure 39), with the majority of landscapes averaging moderate wetland condition. The riverine mid-Murray sections, which include Barmah Forest, were, on average, in good condition noting that this wetland landscape spans multiple regions and area-weighted average condition was calculated across the entire wetland landscape profile and is therefore influenced by wetland condition in the North Central and North East Regions. The wetlands of the montane areas in the south of the catchment were, on average, also in good condition. There were several areas where wetlands averaged poor condition these were characterised by few wetlands and for one, was dominated by Winton Wetlands, which was classified as "poor" due to altered hydrology (Text Box 9).

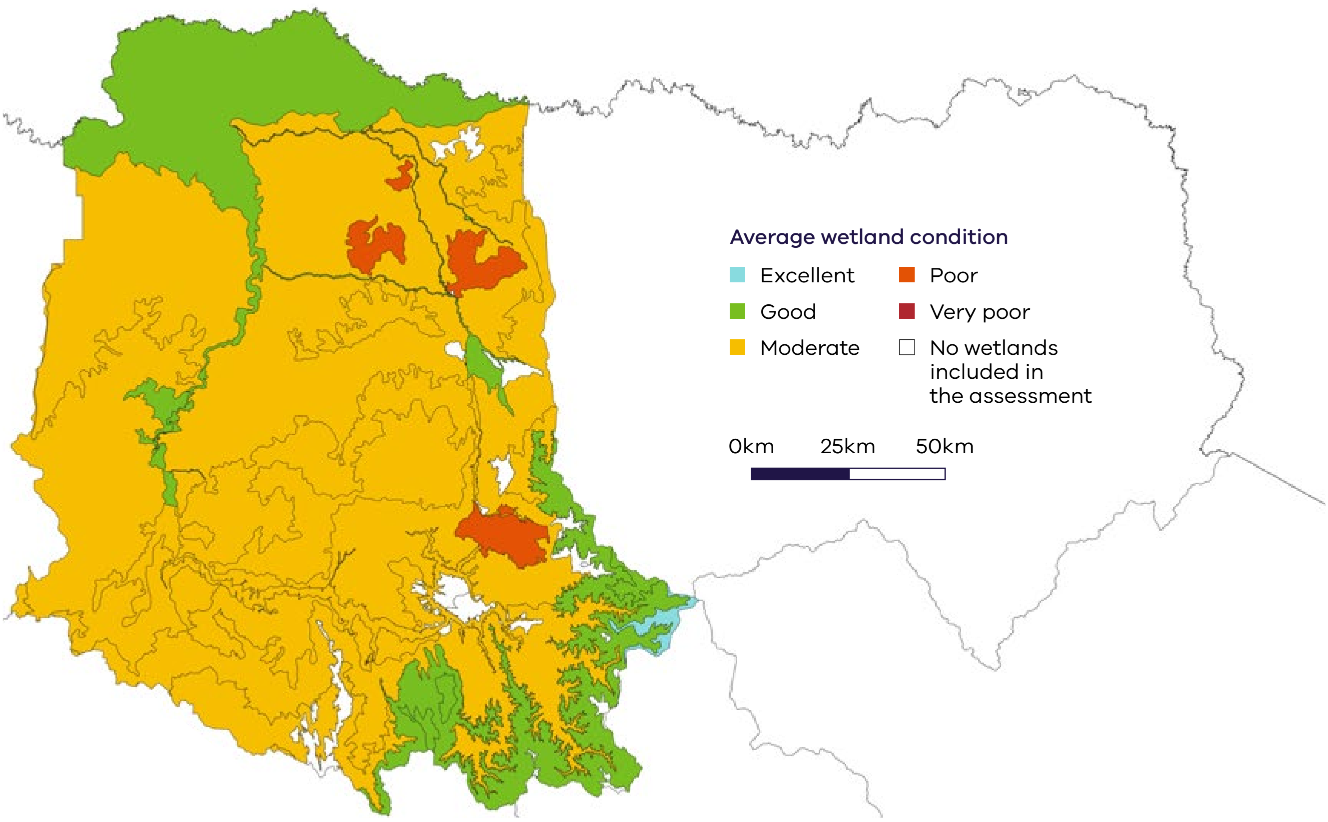


Figure 39. Area weighted wetland condition for Victorian Wetland Landscape Profiles in the Goulburn-Broken Region. Note that some landscape profiles, such as the riverine mid-Murray sections that include Barmah national park cover more than one CMA boundary and so area-weighted scores in these wetland landscape profiles are influenced by results outside the Goulburn-Broken Region.

Altered hydrology is not always a bad thing

The hydrological stress metrics (Johns et al. 2023) which underpin the hydrology sub-index of the VWCA has an underlying assumption that change in hydrological regimes beyond natural variability is an indication of declining wetland condition. While this assumption undoubtedly holds true for most wetland systems, particularly those that are experiencing impacts from a drying climate and water resource use, it is not always the case.

The Winton Wetlands are located in the Goulburn-Broken Region approximately 10 kilometres north east of Benalla. The area was permanently inundated in 1970 by the construction of a 7.5 km, 10 m high embankment along the western margin to establish Lake Mokoan. Lake Mokoan covered around 7880 ha and the permanent inundation within the storage resulted in the death of an estimated 2900 hectares of river red gum woodland.

In 2004, the Victorian Government made the decision to decommission Lake Mokoan and return the area to a more natural wetland state to support wetland ecology, biodiversity, cultural values and passive recreation.

This involved reductions in the magnitude and duration of inundation which were detected by the metrics comprising the hydrology sub-index of the VWCA resulting in a ow condition score for this location. However, in this instance, these changes represent an improvement in condition rather than a decline. See section 2.2.5 for further information on the limitations of the hydrology sub-index of the VWCA.

Text Box 9. Improved hydrology at Winton Wetlands / Yorta Yorta County / photo credit: Simon Casanelia GBCMA

Table 25. Area-weighted average condition scores based on VWI wetland type in the Goulburn-Broken Region. Sub-indices are scored out of 10 and the total score is out of a maximum possible of 50. The four hydrological metrics are shown separately: Magnitude of inundation, duration of inundation, frequency of inundation and the proportion of time a wetland is dry. These are combined into a single overall hydrological score before the final total scores are calculated. Red = very poor, orange = poor, yellow = good, green = very good, blue = excellent

			Hydrology metrics								
Wetland type	Area (ha)	No.	Magnitude	Duration	Frequency	Dry Fraction	Average Hydro.	Soil	Vegetation	Land Use	Total score
Peatlands	56	61	5	6	7	7	6	9	10	10	41
Permanent freshwater lake	2560	30	5	4	5	8	5	7	10	4	28
Permanent freshwater marsh or meadow	463	36	9	9	9	10	9	6	10	9	40
Permanent freshwater swamp	639	22	4	4	4	10	6	10	10	8	38
Permanent river red gum swamp	6294	36	5	5	5	8	6	6	10	7	32
Permanent saline lake	46	1	6	4	8	8	7	6	6	2	22
Permanent shallow wetland/claypan	269	34	5	5	5	6	5	9	10	5	32
Permanent tall marsh	270	4	6	6	6	8	7	10	10	10	43
Temporary freshwater lake	1979	118	7	7	8	8	8	7	8	4	30
Temporary freshwater marsh or meadow	5256	654	7	7	7	8	7	7	9	4	29
Temporary freshwater swamp	4556	1096	7	7	7	8	7	7	9	4	30
Temporary lignum swamp	422	6	4	5	4	6	5	7	10	5	30
Temporary river red gum swamp	29530	513	7	7	8	9	8	9	10	8	41
Temporary saline lake	263	2	4	4	2	8	5	10	10	2	26
Temporary salt marsh	2	1	4	4	4	6	5	6	10	8	31
Temporary shallow wetland/claypan	12087	1364	7	7	8	8	7	7	8	3	29
Temporary shrub swamp	281	232	8	8	8	8	8	9	10	4	33
Temporary Tall Marsh	1216	17	9	8	10	9	9	10	10	10	47

4.4.2 Hydrology

Around 45% of wetland area in the Goulburn-Broken region was assessed as excellent or good with respect to magnitude and duration of inundation, with over half of wetlands having moderate to severe declines in inundation since the 1980s (Figure 40). Wetlands that scored moderate, poor or very poor for hydrology included examples of all wetland types, but some types had higher impacts that others (Table 25). For example, several permanent types of wetlands (peatlands, freshwater lakes, freshwater swamps and river red gum swamps) showed large decreases in magnitude, frequency and / or duration of inundation. There were, however, a number of temporary wetlands, mostly "shallow wetland/claypan" in the Goulburn Basin that had increased magnitude, duration and / or frequency of inundation contributing to lower condition scores. However, it is acknowledged that the assessment method does not account for situations where management actions have changed wetland hydrology since the 1980s to better support wetland values (see Text Boxes 9 and 10).

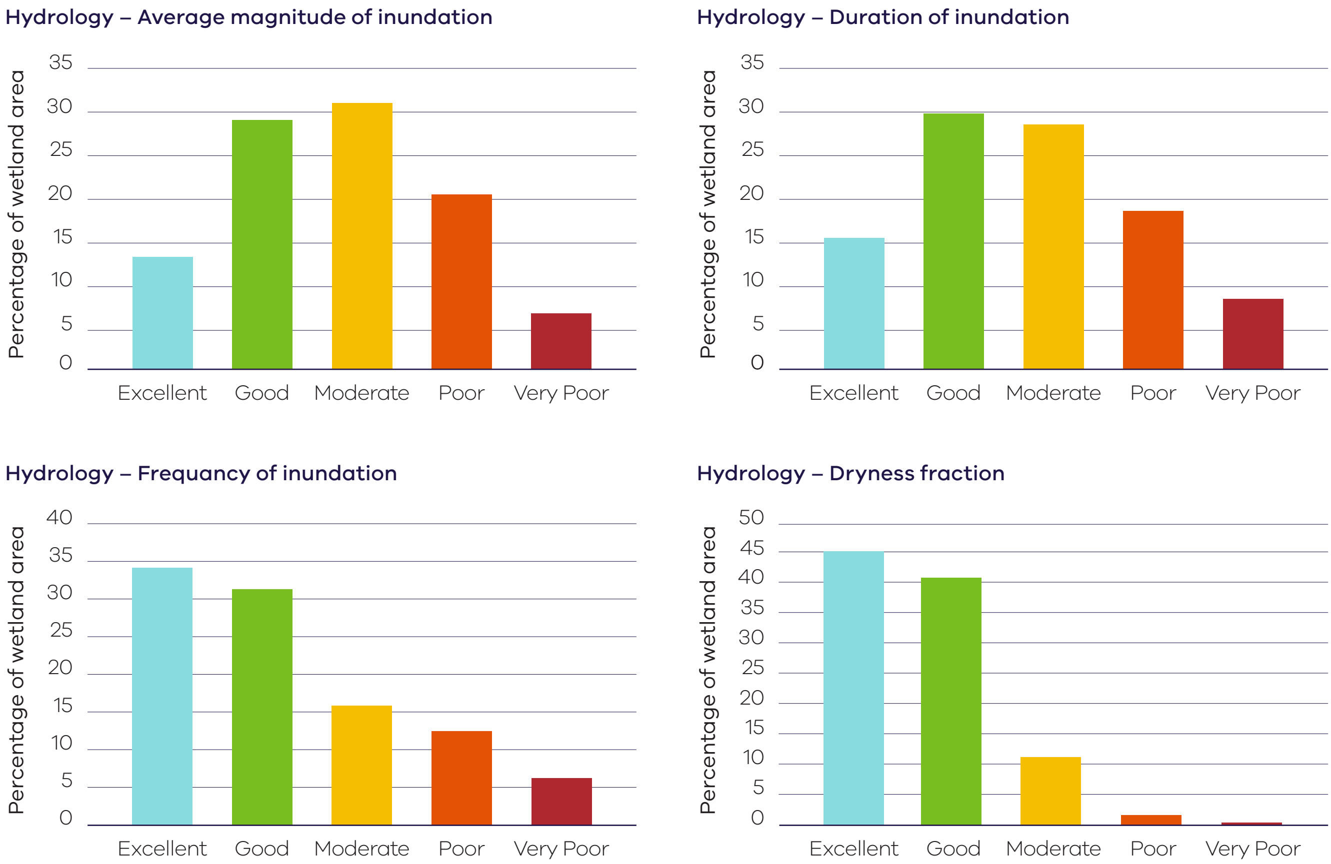


Figure 40. The percentage of wetland area in each condition score class in the Goulburn-Broken Region for average magnitude of inundation (top left) and duration of inundation (top right), frequency of inundation (bottom left) and proportion of time a wetland is dry (bottom right).

4.4.3 Soils

Almost two thirds of wetland area in the Goulburn-Broken region scored excellent or good for soils, indicating only small changes in the area of exposed soil since the 1980s (Figure 41). Wetlands that scored poor or very poor for this sub-index were largely small, temporary marshes and meadows or shallow wetlands / claypans in the Goulburn catchment on private property.

Figure 41. The percentage of wetland area in each condition score class in the Goulburn-Broken Region for the soil sub-index.

4.4.4 Vegetation

Vegetation was in excellent condition across 81% of wetland area and good at 9% (Figure 42). The small amount of wetland in moderate, poor and poor condition with respect to vegetation were mostly small freshwater swamps and marshes on private property in the Goulburn Basin.

Figure 42. The percentage of wetland area in each condition score class in the Goulburn-Broken Region for the vegetation sub-index.

Credit: Sean Phillipson EGCMA

4.4.5 Land use

The Goulburn-Broken Region is dominated by agriculture, which covers around 63% of the entire region. While the majority of wetlands are in agricultural landscapes, there are a large number of wetlands also in conservation reserves and surrounded by native vegetation with over 20% of wetlands scoring "excellent" for this sub-index (Figure 43 and Figure 44). Those wetlands that scored poor or very poor where largely in the cropping region of the lower Goulburn catchment.

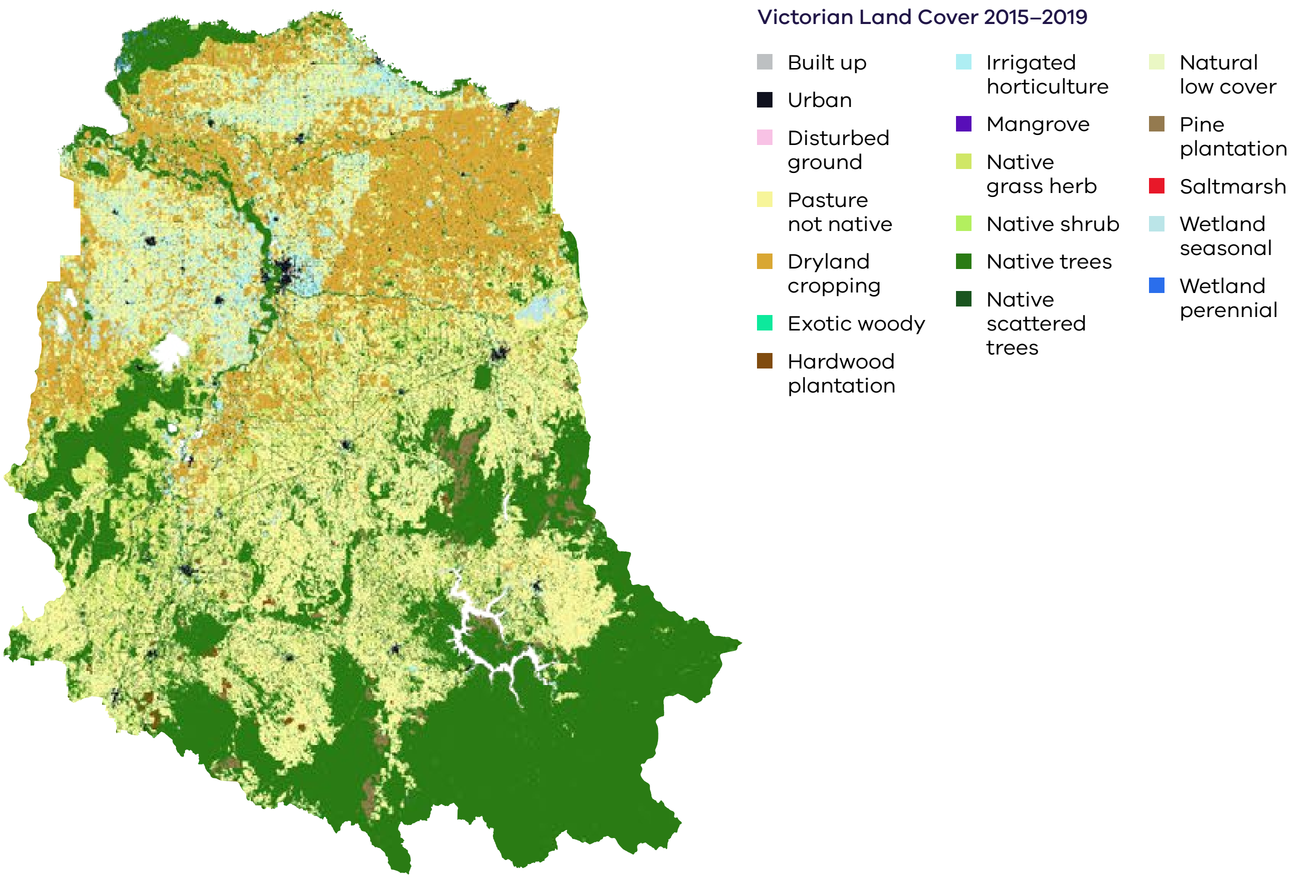


Figure 43. Victorian Land Cover Time Series (2015–2019) for the Goulburn-Broken Region.

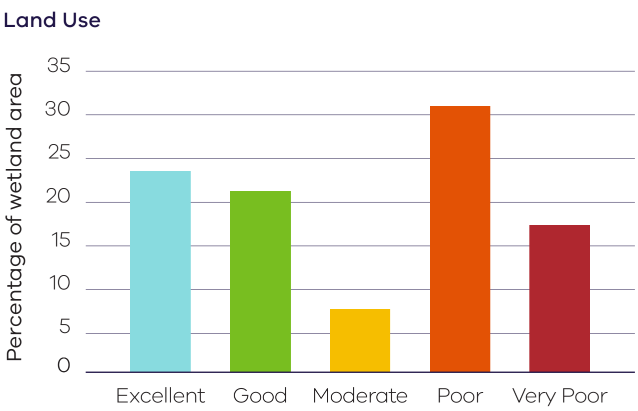


Figure 44. The percentage of wetland area in each condition score class in the Goulburn-Broken Region for the land use sub-index.

4.5 Mallee

The Mallee region is the largest Region in Victoria (40,000 km2) and contains over 1600 natural wetlands covering an area of almost 60,000 hectares. The 2025 Victorian Wetland Inventory (VWI) was used to identify these wetlands (DataVIC). These wetlands are distributed among three basins: Avoca River, Mallee Basin and Wimmera-Avon Rivers basin.

Lake Tyrell, a salt lake, has a surface area of over 17,000 hectares, and represents 28% of the wetland area in the region. For this reason, Lake Tyrell was not included in the assessment as it would overly influence area averaged scores.

The Mallee region contains the Hattah-Kulkyne Lakes, a wetland of international importance listed under the Ramsar Convention. The wetlands of this site support a diversity of inundation dependent plants and animals including the nationally vulnerable regent parrot (*Polytelis anthopeplus*), and endangered winged peppercress (*Lepidium monoplocoides*). The Mallee region also has a number of nationally important wetlands including Kings Billabong Wetland, Lake Wallawalla, Heywood Lakes and the Lindsay and Wallpolla Island floodplains which contain many wetlands and creek systems. These important wetlands represent the diversity of wetland types in the Mallee and include wetlands associated with the Murray River or its anabranches that are primarily seasonal, intermittent or ephemeral wetlands that fill when the Murray River floods, saline wetlands of the centre and south east of the region that are often groundwater fed, freshwater marshes in the Wyperfeld National Park and the freshwater meadows in the south of the region.

Wetlands of the Mallee region are important drought refuges, particularly those wetlands that are fed by groundwater or hold water for extended periods following floods. Threatened species that rely on the region's wetlands include growling grass frog, Murray hardyhead, eastern great egret, hardhead, royal spoonbill and Nankeen night-heron.

4.5.1 Mallee Region Scores

The VCWA found that 42% of natural wetland area in Mallee region was in excellent or good condition (Figure 45). In the Avoca Basin just 7% of wetland area was scored as excellent or good condition, two thirds were in moderate condition and over a quarter in poor or very poor condition (Table 26). There was a higher percentage of wetlands in the Mallee Basin in excellent condition (12%) which included the wetlands of the Hattah-Kulkyne Ramsar Site as well as a wide variety of smaller wetlands, mostly on the Murray floodplain. Almost three quarters of wetlands in the Wimmera-Avon Basin in the Mallee region were in good condition, which also included a variety of wetland types, but was heavily influenced by the Wirrengren Plain, which accounts for almost 70% of the wetland area in that Basin.

In the Mallee Region, 8% of wetland area was in excellent condition, 33% was in good condition, 39% in moderate condition 15% in poor condition and 5% in very poor condition.

Almost 70% of wetland area in the Mallee region is on public land and these wetlands were generally in better condition than those on private property (Table 27). The proportion of wetlands in excellent and good condition on public land was 11% and 43% respectively, compared to 1% and 11% on private property. Almost half of wetland area on private property was in poor or very poor condition.

Overall condition

Figure 45. The percentage of wetland area in each overall condition score class in the Mallee region. The area is the combined area of mapped, inland wetlands that are not classified as dams, excluding Lake Tyrell.

Table 26. The percentage of wetland area in each overall condition score class for River Basins in the Mallee region. The area is the combined area of mapped, inland wetlands that are not classified as dams (excluding Lake Tyrell). "No." is the number of wetlands assessed.

River Basin	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Avoca River	8171	122	<1	6	67	8	19
Mallee	21521	1387	12	28	37	22	1
Wimmera-Avon Rivers	8083	91	6	72	18	3	1

Table 27. The percentage of wetland area in each overall condition score class for wetlands on public and private land in the Mallee region. The area is the combined area of mapped, inland wetlands that are not classified as dams, excluding Lake Tyrell. "No." is the number of wetlands assessed.

	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Private	11619	509	1	11	39	34	14
Public	26156	1091	11	43	40	6	1

Wetland landscape profiles were identified for the IWC and divide the state into regions based on elevation, rainfall and geomorphology. These have been used in this assessment to represent area-weighted average wetland condition spatially. In the Mallee Region average wetland condition across most landscape profiles was moderate (Figure 46). The Riverine Mallee wetlands were, on average, in excellent to good condition, while the non-riverine wetland landscapes were characterised by wetlands in moderate condition. Wetlands in the area of lowland grassy plains to the south east of the Mallee Region were in poor condition, but this wetland landscape profile sits largely in the Wimmera Region and scores were heavily influenced by wetlands outside the Mallee Region.

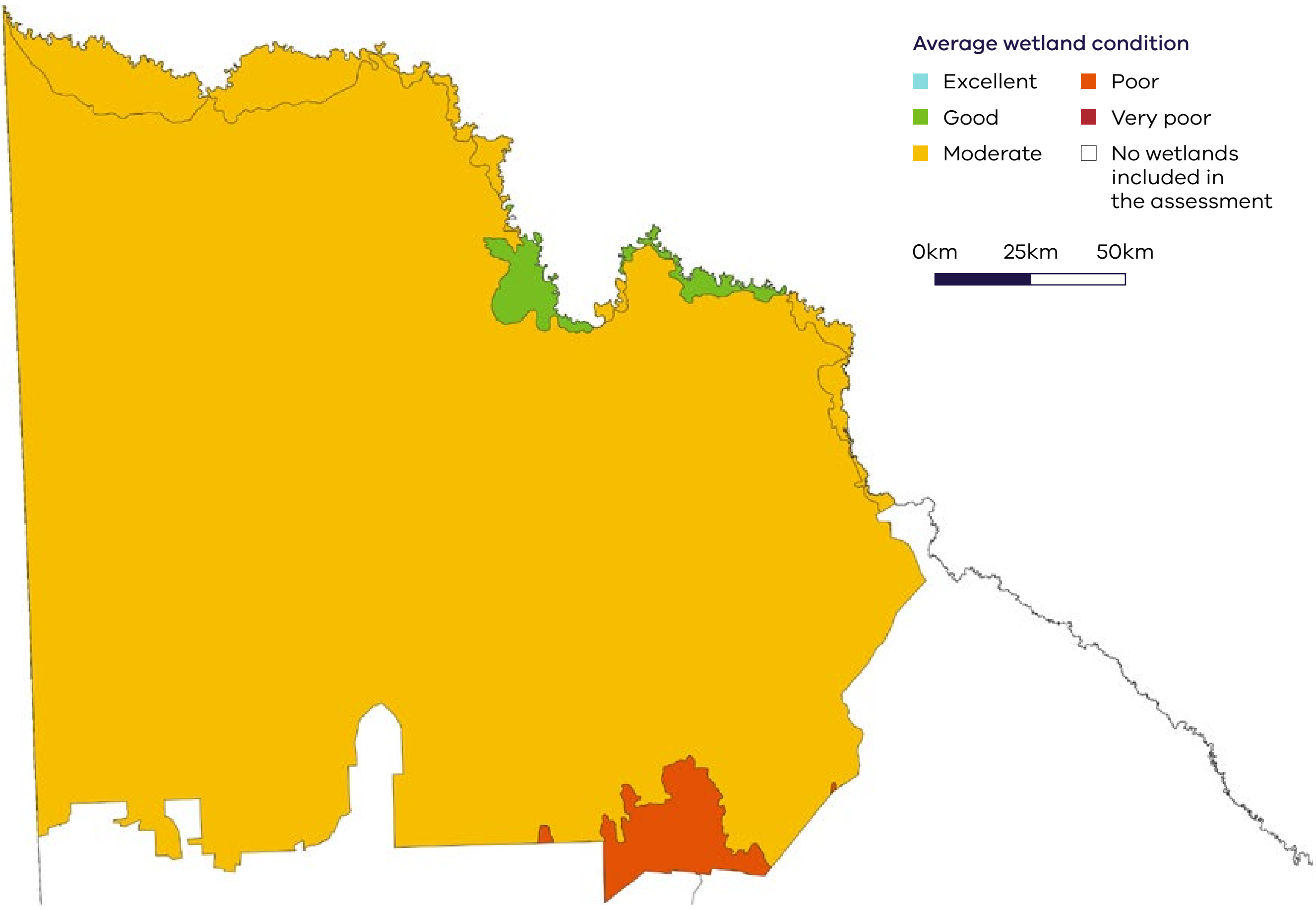


Figure 46. Area weighted wetland condition for Victorian Wetland Landscape Profiles in the Mallee Region.

Table 28. Area-weighted average condition scores based on VWI wetland type in the Mallee Region. Sub-indices are scored out of 10 and the total score is out of a maximum possible of 50. The four hydrological metrics are shown separately: Magnitude of inundation, duration of inundation, frequency of inundation and the proportion of time a wetland is dry. These are combined into a single overall hydrological score before the final total scores are calculated.

			Hydrology metrics								
Wetland type	Area (ha)	No.	Magnitude	Duration	Frequency	Dry Fraction	Average Hydro.	Soil	Vegetation	Land Use	Total score
Permanent freshwater lake	1519	51	8	7	8	9	8	8	9	7	39
Permanent freshwater marsh or meadow	374	15	6	6	7	8	7	10	10	8	40
Permanent freshwater swamp	8	2	8	10	8	7	8	10	8	8	41
Permanent river red gum swamp	11	6	7	6	7	7	7	10	8	8	39
Permanent saline lake	989	31	7	6	7	9	7	7	9	6	34
Permanent saline wetland	369	4	5	5	4	8	6	6	9	4	27
Permanent shallow wetland/claypan	33	10	8	8	7	8	8	9	8	7	38
Permanent shrub swamp	5	1	8	6	6	10	8	10	10	2	30
Temporary black box swamp	102	28	8	7	5	7	7	6	7	9	35
Temporary freshwater lake	6430	188	8	8	8	8	8	8	9	5	35
Temporary freshwater or meadow	722	115	6	6	6	8	7	7	9	8	36
Temporary freshwater swamp	831	83	7	7	6	8	7	6	9	8	35
Temporary lignum swamp	4095	216	6	6	7	8	7	5	7	4	27
Temporary river red gum swamp	486	124	7	7	6	9	7	8	9	9	40
Temporary saline lake	8178	116	7	8	7	7	7	7	9	4	31
Temporary saline swamp	846	37	9	8	9	8	8	7	8	4	31
Temporary salt marsh	36	4	10	10	10	8	10	8	7	5	34
Temporary shallow wetland/claypan	8001	241	9	8	8	8	8	8	8	6	36
Temporary shrub swamp	4738	326	7	7	7	8	7	6	8	6	33
Temporary Tall Marsh	5	2	7	7	7	7	7	7	7	7	34

4.5.2 Hydrology

A little over half the wetland area in the Mallee Region have low amounts of modification to their hydrological regimes since the 1980s, with over 60% of wetland area classified as excellent or good with respect to the magnitude, duration and frequency of inundation as well as the proportion of time that a wetland is dry (Figure 47). However, the method used assesses deviation from the expected 'natural' hydrological variability since the 1980s when the Landsat record began (see section 2.2) and substantial modification of hydrological regimes may have occurred prior to the 1980s due to human activity and water resource use. The method does not assess deviation from pre-European environmental condition.

Around a third of wetlands scored poor or very poor for hydrological sub-indices due to decreased duration, magnitude or frequency of inundation. This is reflected in the assessment of wetland types in the Mallee Region (Table 28), with reduced hydrological condition scores across most common wetland types. A subset of these wetlands has been managed to receive water less frequently to return to required inundation frequencies, which would contribute to this result. Temporary shallow wetlands and temporary freshwater lakes showed lower amounts of modification to hydrological regimes than other types.

The hydrological stress metrics (Johns et al. 2023) which underpin the hydrology sub-index of the VWCA have an underlying assumption that change in hydrological regimes beyond natural variability is an indication of a decline in wetland condition. While this assumption undoubtedly holds true for most wetland systems, particularly those that are experiencing impacts from a drying climate and water resource use, it is not always the case. There may be situations where management of wetland hydrology has improved since the 1980s to better support wetland values, and the VWCA hydrology sub-index may assess hydrology as poorer than expected in these situations (Text Box 10).

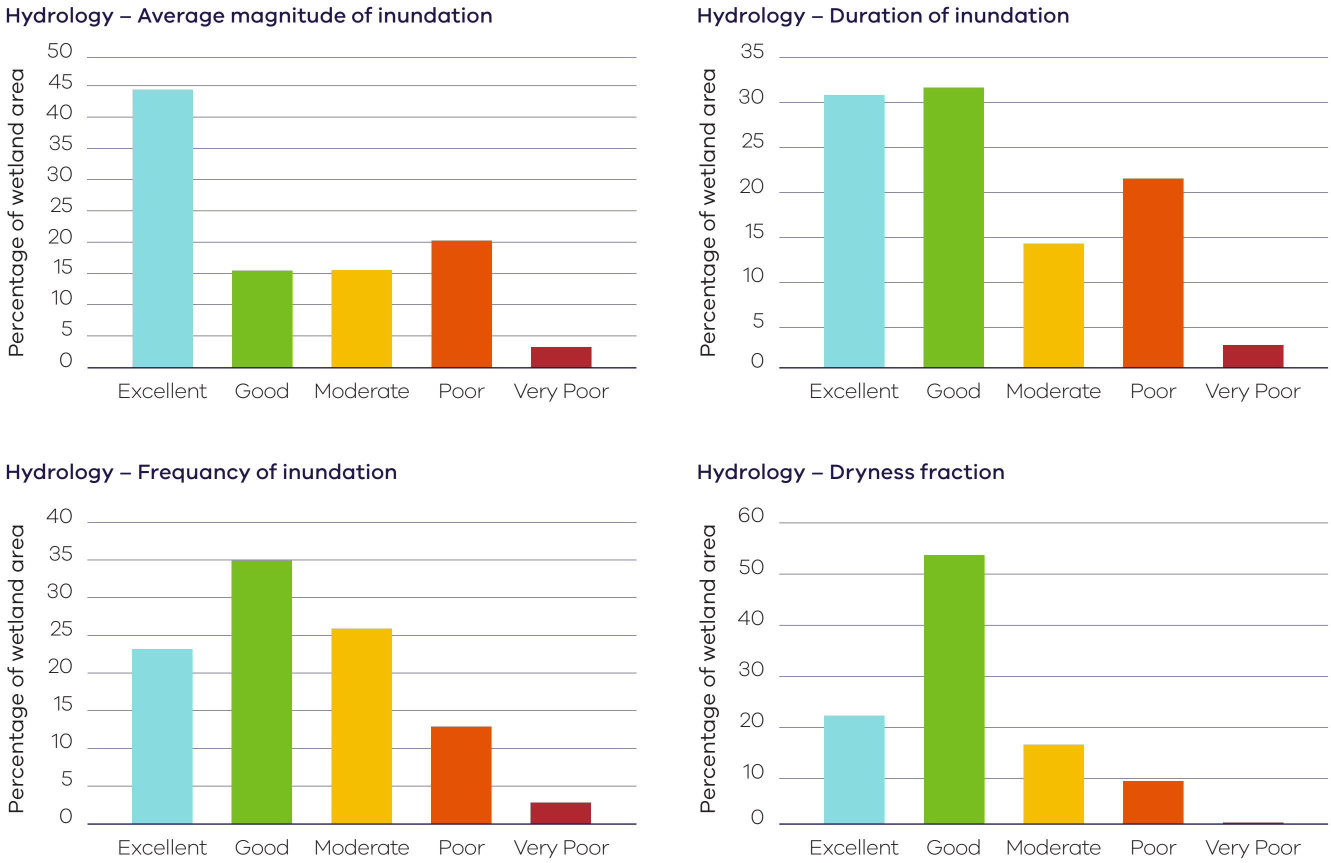


Figure 47. The percentage of wetland area in each condition score class in the Mallee Region for average magnitude of inundation (top left) and duration of inundation (top right), frequency of inundation (bottom left) and proportion of time a wetland is dry (bottom right).

Improving the hydrological regime at Catfish Billabong

Catfish Billabong is a 65-hectare wetland situated within the Merbein Common Flagship Waterway Site. Catfish Billabong supports River Red Gum and Lignum communities, as well as many native fauna species and is a priority for management because of the high environmental, social and cultural heritage values it supports.

The hydrological regime of Catfish Billabong was altered by regulation of the Murray River, with the wetland permanently inundated by the weir pool of Lock 10 at Wentworth, with little variation in water levels. In 2023, a project completed by Mallee Catchment Management Authority (CMA) installed an environmental flow regulator at the site to reinstate a more natural hydrological regime, through introducing wetting and drying cycles, giving local flora and fauna opportunities to benefit. The structure will enable water to be delivered to inundate the full extent of the wetland as well as isolating the wetland from the river to enable full or partial drying. This will improve water quality and productivity when the wetland is refilled and has the added benefit of controlling carp within the wetland.

The regulator can be opened to refill the wetland (the wetland will be pumped and only receive natural inflows in very high rivers). Importantly, the new regulator will also allow water to be retained at higher levels to water surrounding vegetation, either via capturing river flow peaks during winter and spring, or using temporary pumps to surcharge the wetland. Native fish will be able to enter and exit the wetland when the gates are open, and fish eggs and larvae will be able to leave the wetland system during the drawdown (draining) phase.

Additional benefits will include the ability for Traditional Owners to inform ecological watering cycles to support cultural knowledge and values for the site. The site also offers the wider community opportunities to utilise the site through recreational activities including fishing, canoeing, camping, bird watching and hiking.

Text Box 10. Improving the hydrological regime at Catfish Billabong / Latji Latji Country / photo credit: Mallee CMA

4.5.3 Soils

Over half of the wetland area in the Mallee region scored excellent or good for soils, indicating only small changes in the area of exposed soil since the 1980s (Figure 48). Those that scored poor or very poor included representative of most wetland types, but they were predominantly in the Mallee Basin, with lignum swamps in particular showing increased areas of exposed soil. It is acknowledged that many wetlands in the Mallee region, as across most of Victoria, experience cycles of wetting and drying. The soils sub-index of the VWCA examines changes in exposed soils in the previous five years to the rest of the data record (i.e. since the 1980s; see section 2.2.6). Therefore, if wetlands have experienced high variability in exposed soils since the 1980s, an impact beyond that level of variability would be needed for the sub-index to score poorly.

Figure 48. The percentage of wetland area in each condition score class in the Mallee Region for the soil sub-index.

4.5.4 Vegetation

The condition of vegetation varied from very poor to excellent among wetlands of the Mallee region, however the vast majority of wetland area had good or excellent vegetation. Vegetation was in excellent condition across 43% of wetland area and good at 40% (Figure 49). The small number of wetlands that scored moderate for this sub-index included temporary shrub swamps on private property in the Mallee Basin.

Figure 49. The percentage of wetland area in each condition score class in the Mallee Region for the vegetation sub-index.

4.5.5 Land use

The Mallee Region is dominated by agriculture, which covers around 62% of the region. This includes large areas of dryland cropping, with irrigated horticulture along the Murray (Figure 50). Native vegetation has been retained in the region's large parks and reserves including Murray-Sunset, Big Desert, Wyperfeld and Hattah-Kulkyne; extensive tracts of riverine and dryland state forests; and over 500 small reserves. Around 7% of wetlands are surrounded by natural land uses, scoring "excellent" and a further 18% scoring "good" (Figure 51). There were around 34% of wetlands that scored moderate for land use, 22% that scored poor and 19% that score very poor.

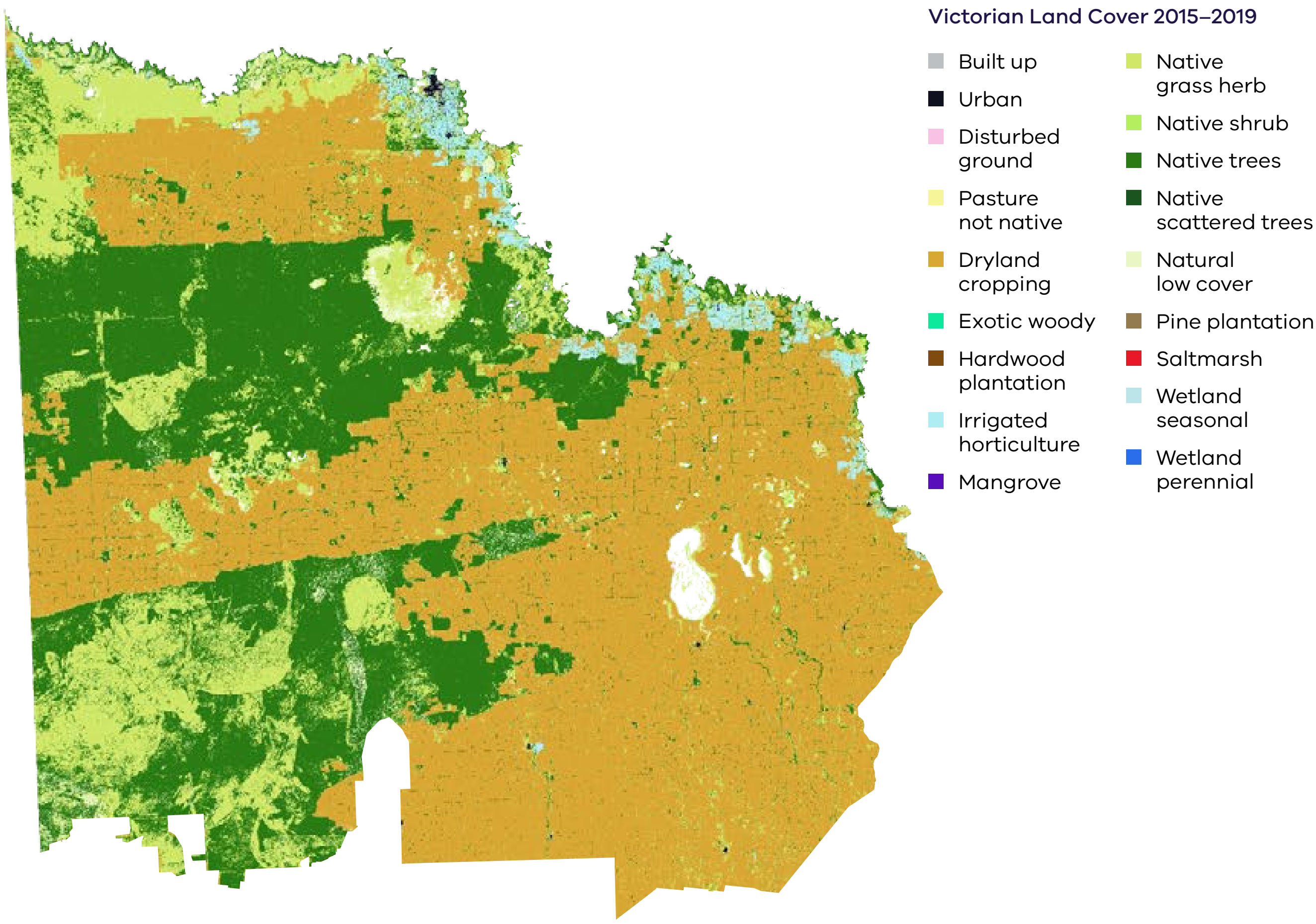


Figure 50. Victorian Land Cover Time Series (2015–2019) for the Mallee Region.

Figure 51. The percentage of wetland area in each condition score class in the Mallee Region for the land use sub-index.

4.6 North Central

The North Central region contains over 2600 natural wetlands covering around 90,000 hectares, which comprises 3% of the Region. These wetlands are distributed among four river basins: the Avoca River, Campaspe River, Loddon River and Wimmera-Avon River basins.

The region supports a diversity of wetlands with 22 of the 26 inland wetland types represented. This includes the largest extent of lignum swamps in Victoria as well as significant areas of river red gum swamp, freshwater lakes and temporary shallow wetland/claypans.

The region includes two wetlands of international importance, listed under the Ramsar Convention, the Kerang Wetlands and Gunbower Forest. In addition, there are 10 wetlands of national importance including Woolshed Swamp, Lake Buloke, Ghow (Kow) Swamp and Lake Merin Merin.

The wetlands of the North Central region support a diversity of inundation dependant plants and animals. Temporary and permanent lakes and marshes play a pivotal role in supporting an abundance of waterbirds. During periods of drought, when the surrounding landscapes are dry, permanent wetlands support large congregations of ducks, swans, large-bodied waders and fish-eating bird species. The shallow, temporary wetlands support large numbers of small wader birds both Australian residents and international migrants. The wetlands of the region are also important for supporting populations of several nationally (EPBC) listed species including Australasian bittern (*Botaurus poiciloptilus*), curlew sandpiper (*Calidris ferruginea*), Murray hardyhead (*Craterocephalus fluviatilis*), river swamp wallaby grass (*Amphibromus fluitans*), stiff groundsel (*Senecio behrianus*) and winged peppercress (*Lepidium monoplocoides*).

4.6.1 North Central Region Scores

The 2025 Victorian Wetland Condition Assessment found that 18% of natural wetland area in North Central region was in excellent or good condition, 40% was in moderate condition and 42% in poor or very poor condition (Figure 52). Wetland condition follows a similar pattern in the Avoca and Campaspe Basins, with over half of wetland area in moderate condition and around 40% in poor or very poor condition, with smaller proportions in good or excellent condition (Table 29). There is a greater proportion of wetlands in excellent (17%) and good (11%) condition in the Loddon Basin. This reflects the excellent condition of Gunbower Forest, which accounts for 15% of the total wetland area in the Loddon Basin, as well as the good condition scores of some of the wetlands in the Kerang Wetlands Ramsar Site. By contrast, three quarters of the wetlands in the part of the Wimmera-Avon Basin in the North Central Region were in poor or very poor condition.

> In the North Central Region, 10% of wetland area was in excellent condition, 8% was in good condition, 40% in moderate condition 38% in poor condition and 4% in very poor condition.

Many wetlands in the North Central region are in reserves managed for conservation and 40% of wetland area is on public land. These wetlands, largely in conservation reserves and state forest are, on average, in better condition than those on private property (Table 30). Around one third (34%) of wetlands on public land were in good or excellent condition compared to 7% on private property. There was also a smaller proportion of wetlands on public land in very poor condition (1%) compared to those on private property (7%).

Overall condition

Figure 52. The percentage of wetland area in each overall condition score class in the North Central region. The area is the combined area of mapped, inland wetlands that are not classified as dams.

Table 29. The percentage of wetland area in each overall condition score class for River Basins in the North Central region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

River Basin	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Avoca River	25750	366	1	4	54	33	8
Campaspe River	2889	308	1	7	55	32	5
Loddon River	56099	1643	17	11	38	32	2
Wimmera-Avon Rivers	15356	299	0	5	20	71	4

Table 30. The percentage of wetland area in each overall condition score class for wetlands on public and private land in the North Central region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Private	59254	2151	1	6	47	39	7
Public	40545	452	23	11	29	37	1

Wetland landscape profiles were identified for the IWC and divide the state into regions based on elevation, rainfall and geomorphology. These have been used in this assessment to represent area-weighted average wetland condition spatially. In the North Central Region average wetland condition in wetland landscape profiles ranged from excellent to poor, with the majority of the region averaging moderate wetland condition (Figure 53). The wetlands within the Riverine – mid-Murray region and parts of "the foothills, inland slopes" were, on average, in good condition. While wetlands in the low grassy plains of the Wimmera-Avon and Birch's Creek, had wetlands that were on average in poor condition.

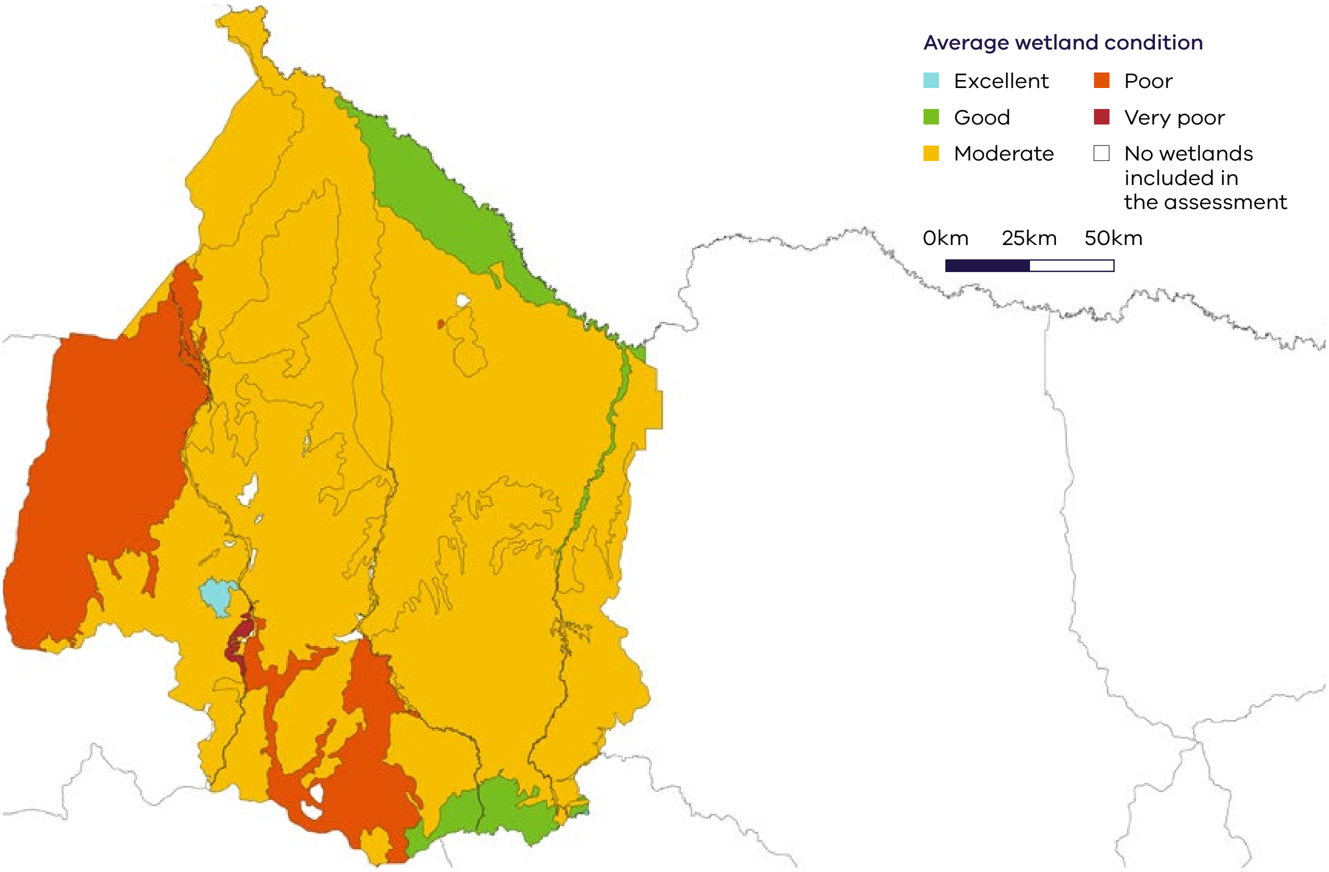


Figure 53. Area weighted wetland condition for Victorian Wetland Landscape Profiles in the North Central Region.

Table 31. Area-weighted average condition scores based on VWI wetland type in the North Central Region. Sub-indices are scored out of 10 and the total score is out of a maximum possible of 50. The four hydrological metrics are shown separately: Magnitude of inundation, duration of inundation, frequency of inundation and the proportion of time a wetland is dry. These are combined into a single overall hydrological score before the final total scores are calculated.

			Hydrology metrics								
Wetland type	Area (ha)	No.	Magnitude	Duration	Frequency	Dry Fraction	Average Hydro.	Soil	Vegetation	Land Use	Total score
Permanent freshwater lake	7698	29	7	8	7	8	7	9	10	3	32
Permanent freshwater marsh or meadow	227	5	6	6	5	8	6	8	10	6	34
Permanent freshwater swamp	12	11	6	6	7	6	6	8	9	8	37
Permanent river red gum swamp	185	15	9	7	8	8	8	10	10	6	39
Permanent saline lake	769	10	4	3	3	8	5	5	10	4	24
Permanent saline wetland	101	4	2	3	2	10	4	6	10	3	24
Permanent shallow wetland/claypan	301	21	6	8	8	8	8	10	9	4	34
Permanent shrub swamp	5	1	6	8	8	8	8	10	10	6	38
Permanent tall marsh	4	2	6	7	5	8	7	4	10	4	26
Temporary black box swamp	100	4	9	9	9	8	9	4	8	4	26
Temporary freshwater lake	18778	275	5	5	5	7	6	7	9	4	27
Temporary freshwater marsh or meadow	1831	105	6	6	6	8	7	7	9	4	29
Temporary freshwater swamp	4452	538	7	7	8	8	8	7	9	3	29
Temporary lignum swamp	17343	398	6	6	6	8	7	7	8	3	27
Temporary paperbark swamp	139	4	8	8	6	9	8	9	10	2	30
Temporary river red gum swamp	13746	241	6	8	7	8	7	7	10	8	39
Temporary saline lake	3806	31	8	8	8	8	8	6	10	4	31
Temporary saline swamp	2676	27	4	5	5	6	5	7	9	4	27
Temporary salt marsh	453	3	9	9	8	8	8	10	8	4	34
Temporary shallow wetland/claypan	21988	744	8	8	8	8	8	7	8	3	29
Temporary shrub swamp	5126	131	6	6	6	8	7	7	8	4	30
Temporary Tall Marsh	59	4	7	7	7	10	8	10	9	9	42

4.6.2 Hydrology

Around half of wetlands in the North Central region scored excellent or good for magnitude, duration and frequency of inundation, indicating relatively small changes in these metrics since the 1980s (Figure 54). However, over a third of wetlands scored poor or very poor with respect to magnitude, duration and frequency of inundation. Wetlands that scored moderate, poor or very poor for hydrology included examples of all wetland types, but some types had higher impacts that others (Table 31). In particular, permanent saline lakes and saline wetlands showed, on average, large decreases in magnitude, frequency and duration of inundation. There were also declines in hydrological metrics in temporary freshwater lakes, temporary freshwater marshes and meadows, temporary lignum swamps and temporary saline swamps. The majority of altered hydrology was related to declines in inundation, but there were a small number of freshwater lakes that had increased inundation impacting hydrological regimes.

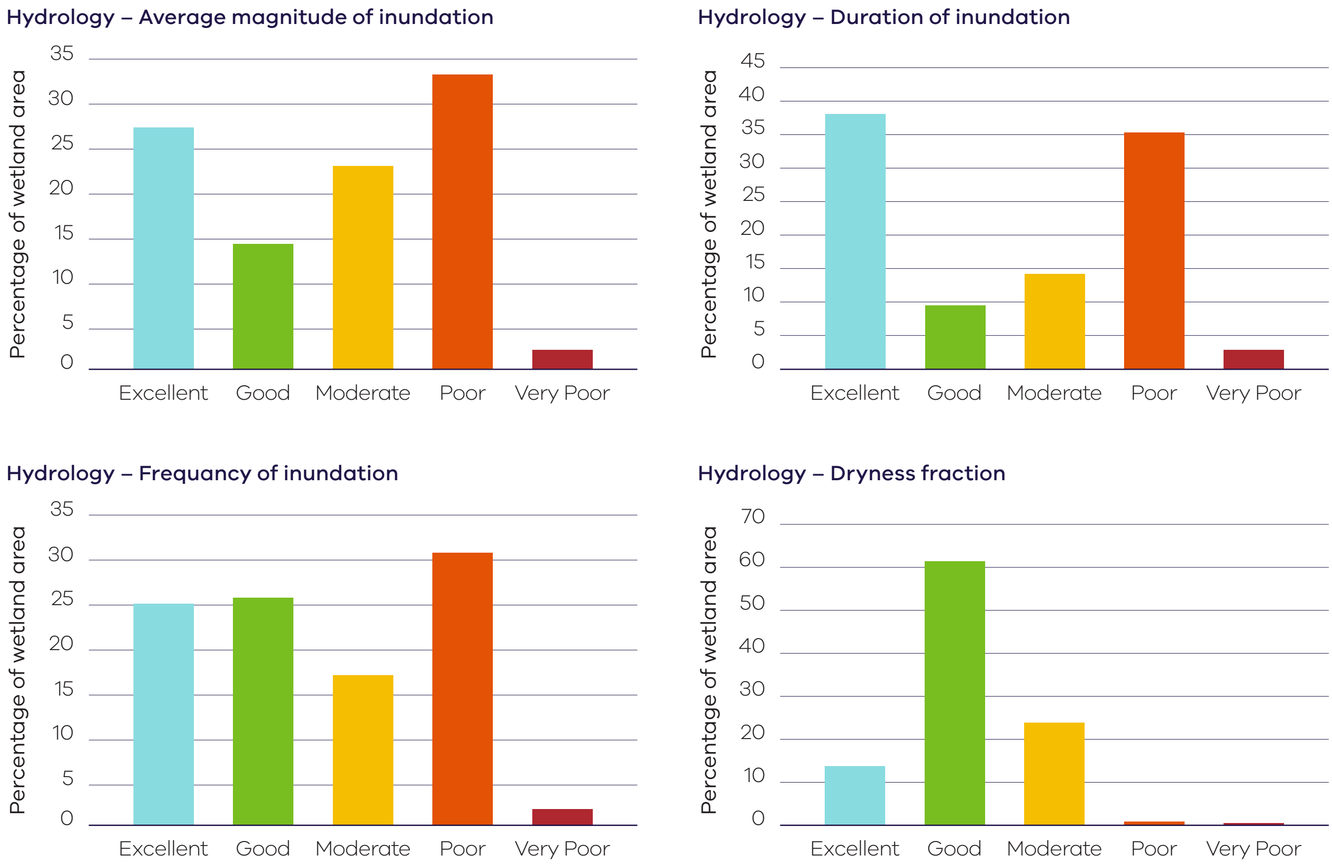


Figure 54. The percentage of wetland area in each condition score class in the North Central Region for average magnitude of inundation (top left) and duration of inundation (top right), frequency of inundation (bottom left) and proportion of time a wetland is dry (bottom right).

4.6.3 Soils

Around half of wetland area in the North Central region scored excellent or good for soils, indicating only small changes in the area of exposed soil since the 1980s (Figure 55). Wetlands across most wetland types had areas that scored poor or very poor for this sub-index, but particularly permanent and temporary saline lakes.

Soil

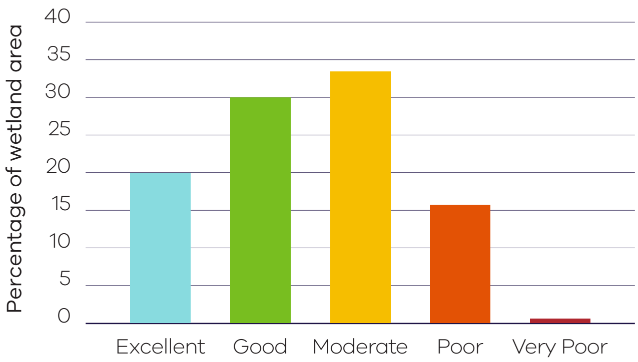


Figure 55. The percentage of wetland area in each condition score class in the North Central Region for the soil sub-index.

4.6.4 Vegetation

Vegetation was in excellent condition across 59% of wetland area and good at 22% (Figure 56). That is, there has been little change, beyond natural variability in wetland vegetation extent since the 1980s. The small amount of wetland in moderate, poor and poor condition were scattered across all basins and most wetland types but included a number of lignum and shrub swamps.

Vegetation

Figure 56. The percentage of wetland area in each condition score class in the North Central Region for the vegetation sub-index.

4.6.5 Land use

The North Central Region is dominated by agriculture, with only 30% of the extent of native vegetation remaining. The land is dominated by dryland cropping, which accounts for over 40% of the region, with grazing accounting for a further 13% (Figure 57). Around 11% of wetlands scored "excellent" or "good" for this sub-index which were within areas of native vegetation or low intensity land use (Figure 58). The majority of wetlands scored poor (56%) or very poor (26%) reflecting the extent of wetlands in agricultural landscapes with little or no native vegetation within a one kilometre buffer. Some of these wetlands in intensive agricultural landscapes may not function well as wetland ecosystems anymore, however they remain in the Victorian Wetland Inventory (VWI), which underpins the current assessment, until they have been physically removed from the landscape (i.e. built over).

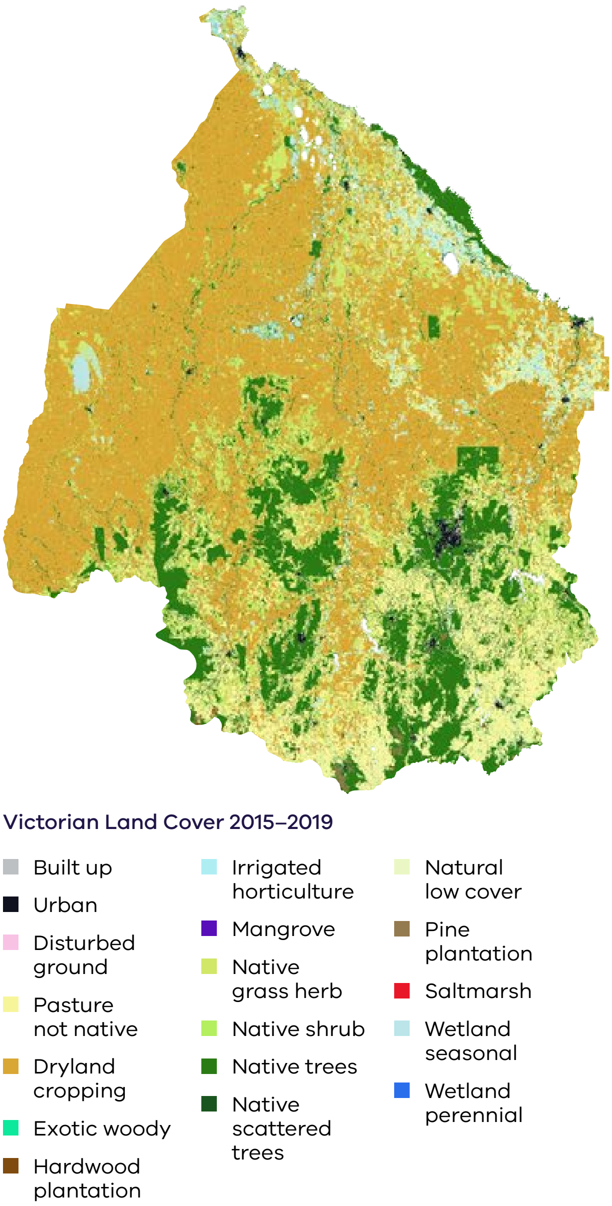


Figure 57. Victorian Land Cover Time Series (2015–2019) for the North Central Region.

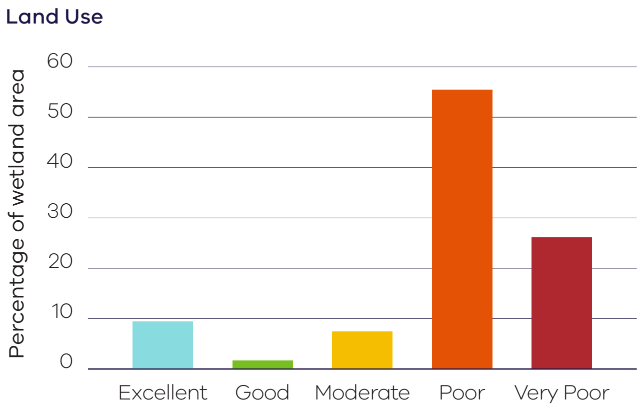


Figure 58. The percentage of wetland area in each condition score class in the North Central Region for the land use sub-index.

4.7 North East

The North East region contains over 3300 natural wetlands covering around 14,500 hectares. The 2025 Victorian Wetland Inventory (VWI) was used to identify these wetlands (DataVIC). These wetlands are distributed across three river basins: the Kiewa River, Ovens River, and Upper Murray River basins. All mapped, natural wetlands in the region are fresh, including swamps, marshes, lakes and meadows. The North East region contains the largest extent of peatlands in the state (a nationally endangered ecological community; Alpine Sphagnum Bogs and Associated Fens) with 1065 peat wetlands covering 2128 hectares.

The region supports several wetlands of national importance listed on the Directory of Important Wetlands in Australia. This includes alpine peatlands located across three geographic regions: The Bogong High Plains, Mt Buffalo and Dinner Plain as well as lowland wetlands on the floodplain of the Ovens River. The region's wetlands are home to several endemic and threatened species including alpine water skink (*Eulamprus kosciuskoi*), alpine bog skink (*Pseudemoia cryodroma*) and reddish bog-heath (*Epacris glacialis*).

4.7.1 North East Region Scores

The VWCA found that 43% of the natural wetland area in the North East region was in excellent or good condition, almost half were in moderate condition and 10% in poor or very poor condition (Figure 59). Wetland condition follows a similar pattern in each of the river basins of the North East region (Table 32). There is a greater proportion of wetlands in excellent condition (34%) in the Kiewa Basin, compared to the Ovens (14%) and Upper Murray (21%).

In the North East Region, 19% of wetland area was in excellent condition, 24% was in good condition, 46% in moderate condition 9% in poor condition and 1% in very poor condition.

Many wetlands in the North East region are in reserves managed for conservation and 30% of wetland area is on public land. These wetlands, largely in conservation reserves and state forest are, on average, in better condition than those on private property (Table 33). Almost half of wetland area on public land were in excellent condition and a further 26% in good condition, compared to 7% and 23% respectively on private land.

Overall condition

Figure 59. The percentage of wetland area in each overall condition score class in the North East region. The area is the combined area of mapped, inland wetlands that are not classified as dams.

Table 32. The percentage of wetland area in each overall condition score class for River Basins in the North East region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

River Basin	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Kiewa River	2127	652	34	19	35	11	2
Ovens River	7059	1474	14	28	49	8	1
Upper Murray River	4970	1262	21	21	46	11	1

Table 33. The percentage of wetland area in each overall condition score class for wetlands on public and private land in the North East region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Private	9929	1887	7	23	55	13	2
Public	4227	1501	48	26	25	0	0

Wetland landscape profiles were identified for the IWC and divide the state into regions based on elevation, rainfall and geomorphology. These have been used in this assessment to represent area-weighted average wetland condition spatially. In the North East Region, average wetland condition within wetland landscapes ranged from excellent to poor (Figure 60). Results indicate that the areas of wetland in alpine – sub-alpine landscapes were, on average, in excellent to good condition, as were the wetlands in the Riverine – mid-Murray land scape along the lower Ovens River. Wetlands areas in the drier western hills, tablelands and inland slopes, were, on average, in moderate condition as were wetlands areas on lowland riparian floodplains. The small number of wetland landscape profiles where average condition was poor, were characterised by small total wetland extent (< 33 hectares).

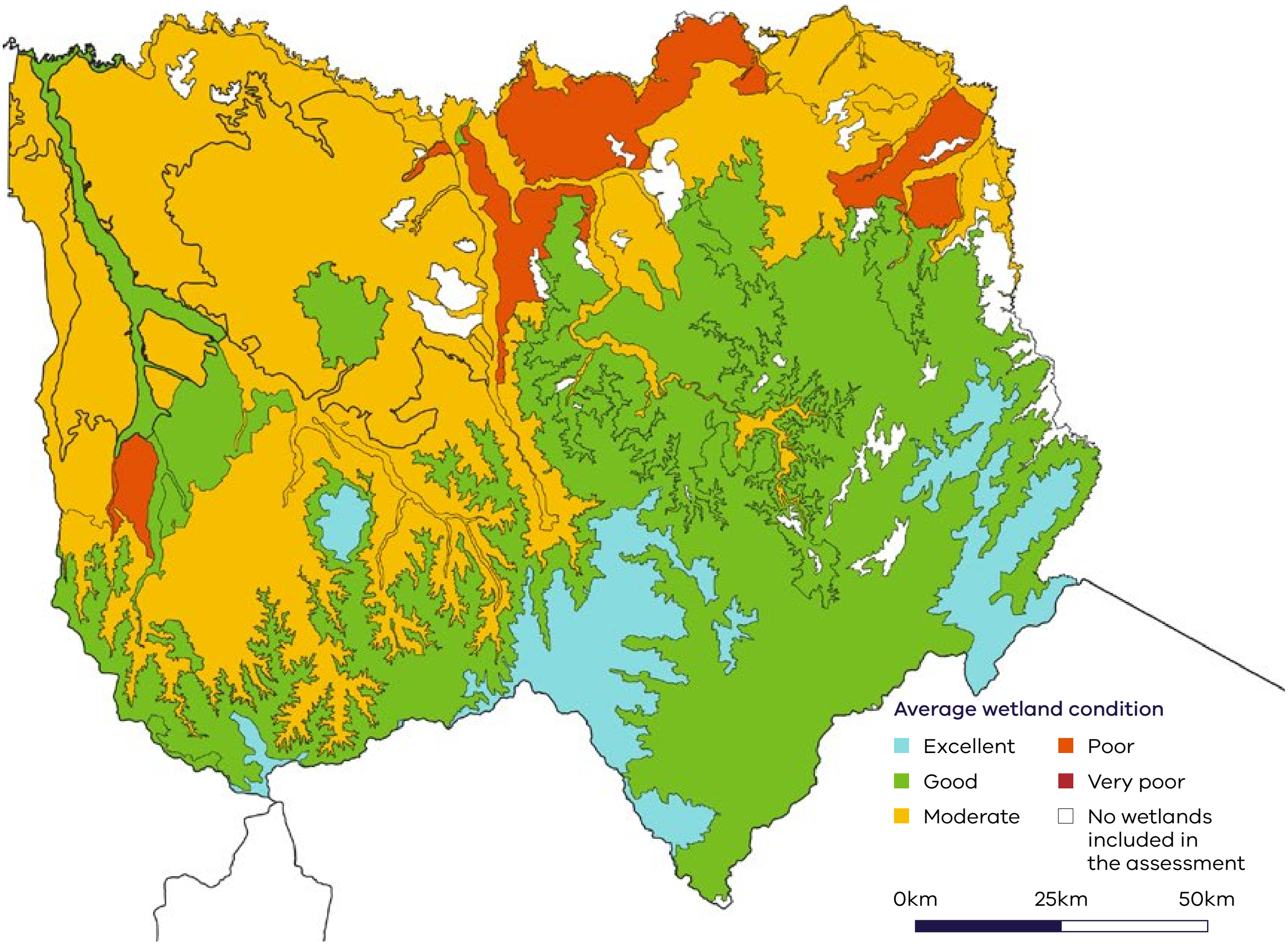


Figure 60. Area weighted wetland condition for Victorian Wetland Landscape Profiles in the North East Region.

Table 34. Area-weighted average condition scores based on VWI wetland type in the North East Region. Sub-indices are scored out of 10 and the total score is out of a maximum possible of 50. The four hydrological metrics are shown separately: Magnitude of inundation, duration of inundation, frequency of inundation and the proportion of time a wetland is dry. These are combined into a single overall hydrological score before the final total scores are calculated.

			Hydrology metrics								
Wetland type	Area (ha)	No.	Magnitude	Duration	Frequency	Dry Fraction	Average Hydro.	Soil	Vegetation	Land Use	Total score
Peatlands	2128	1065	8	8	8	9	8	8	10	10	43
Permanent freshwater lake	479	34	7	7	8	8	7	9	9	6	37
Permanent freshwater sedge/ grass marsh or meadow	225	40	8	8	9	8	8	9	10	6	39
Permanent freshwater swamp	36	11	8	9	9	6	8	10	10	6	38
Permanent river red gum swamp	232	70	8	8	8	8	8	9	10	7	41
Permanent shallow wetland/claypan	500	42	8	5	6	8	7	8	10	7	37
Permanent tall marsh	160	1	6	6	6	8	7	6	10	6	33
Temporary freshwater lake	2087	82	8	8	7	9	8	8	9	4	32
Temporary freshwater sedge/ grass marsh or meadow	1340	445	8	8	8	8	8	8	9	4	33
Temporary freshwater swamp	2000	415	8	8	9	8	8	8	9	4	33
Temporary river red gum swamp	1857	549	8	7	8	9	8	8	10	5	35
Temporary shallow wetland/claypan	3113	634	8	8	9	8	8	8	9	4	32

4.7.2 Hydrology

Over 70% of wetlands in the North East region scored excellent or good for magnitude, duration and frequency of inundation and dryness fraction (proportion of time a wetland is dry), indicating relatively small changes in these metrics since the 1980s (Figure 61). Wetlands that scored moderate, poor or very poor for hydrology included examples of all wetland types, but some types had higher impacts that others (Table 34). In particular, permanent shallow wetland/ claypans experienced declines in inundation frequency as did temporary river red gum swamps. Small areas of freshwater lakes and swamps in the Kiewa Basin showed large increases in inundation frequency and duration. These tended to be on private land.

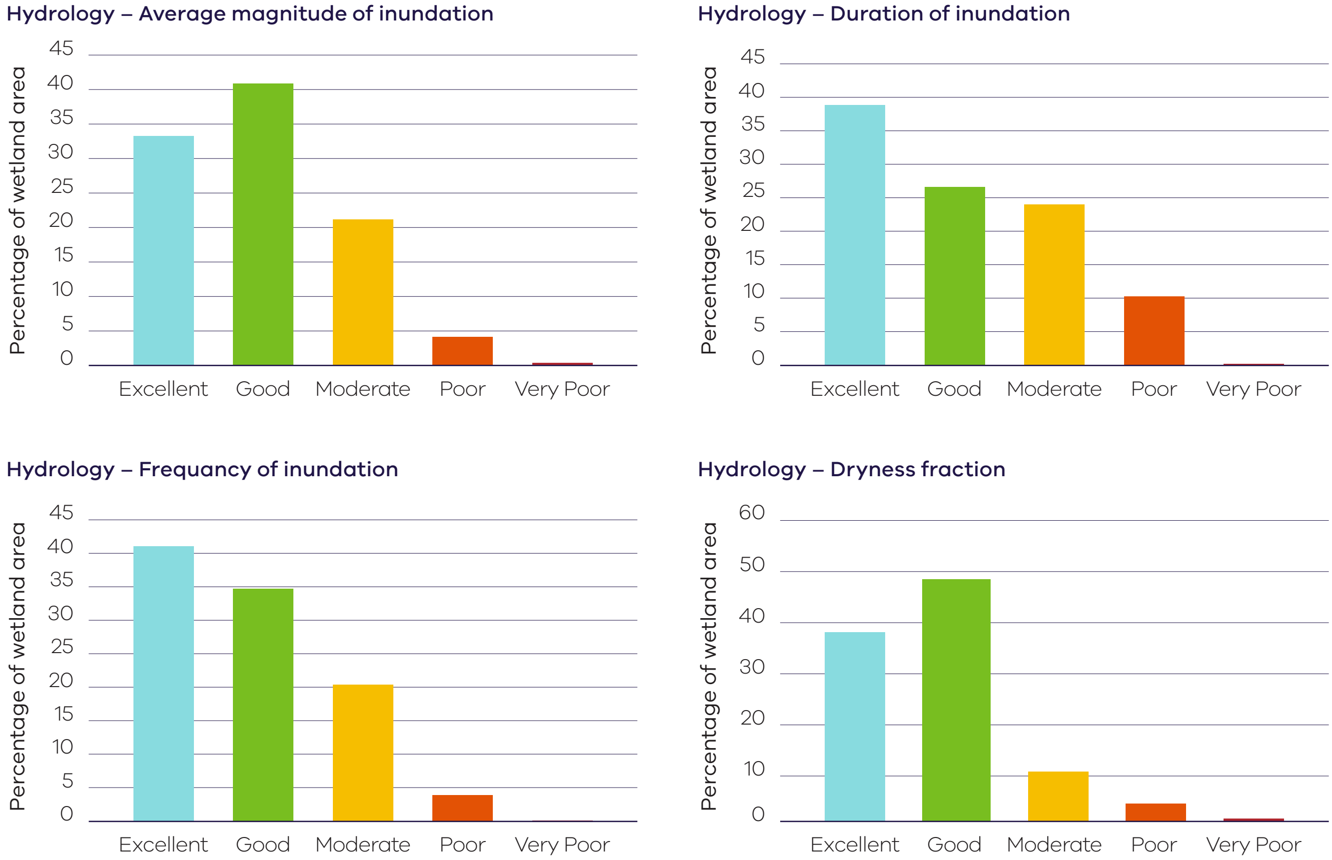


Figure 61. The percentage of wetland area in each condition score class in the North East Region for average magnitude of inundation (top left) and duration of inundation (top right), frequency of inundation (bottom left) and proportion of time a wetland is dry (bottom right).

4.7.3 Soils

Around three quarters of wetland area in the North East region scored excellent or good for soils, indicating only small changes in the area of exposed soil since the 1980s (Figure 62). Wetlands across most wetland types had areas that scored poor or very poor for this sub-index, but particularly temporary freshwater swamps and shallow wetlands / claypans in the Ovens and Upper Murray Basins.

Figure 62. The percentage of wetland area in each condition score class in the North East Region for the soil sub-index.

4.7.4 Vegetation

Vegetation was in excellent condition across 76% of wetland area and good at 16% (Figure 63). The small amount of wetland area in moderate, poor and poor condition were largely small shallow wetland / claypan and temporary freshwater sedge/grass marshes or meadows in the Upper Murray Basin.

Figure 63. The percentage of wetland area in each condition score class in the North East Region for the vegetation sub-index.

4.7.5 Land use

The North East Region has retained 70% of its native vegetation extent. In the remaining 30% of the region, grazing on non-native pasture dominates most of the land, with areas of hardwood plantation in the slopes and foothills and dryland cropping on lower alluvial plans (Figure 64). Despite the large extents of native vegetation only 26% of wetlands scored excellent or good for this sub-index, indicating that the greatest areas (74%) of wetland occur in lower lying areas that have been cleared for agriculture (Figure 65). Agricultural land cover can represent threats to wetlands via physical (e.g. trampling and grazing by livestock), biogeochemical (e.g. nutrient loading, and disruption of nutrient cycling leading to water quality degradation), and biological (e.g. invasive species risks) pathways (see section 2.2.4). Improving land management on private land through better conservation practices and waterway policies can help mitigate these issues and enhance ecological health.

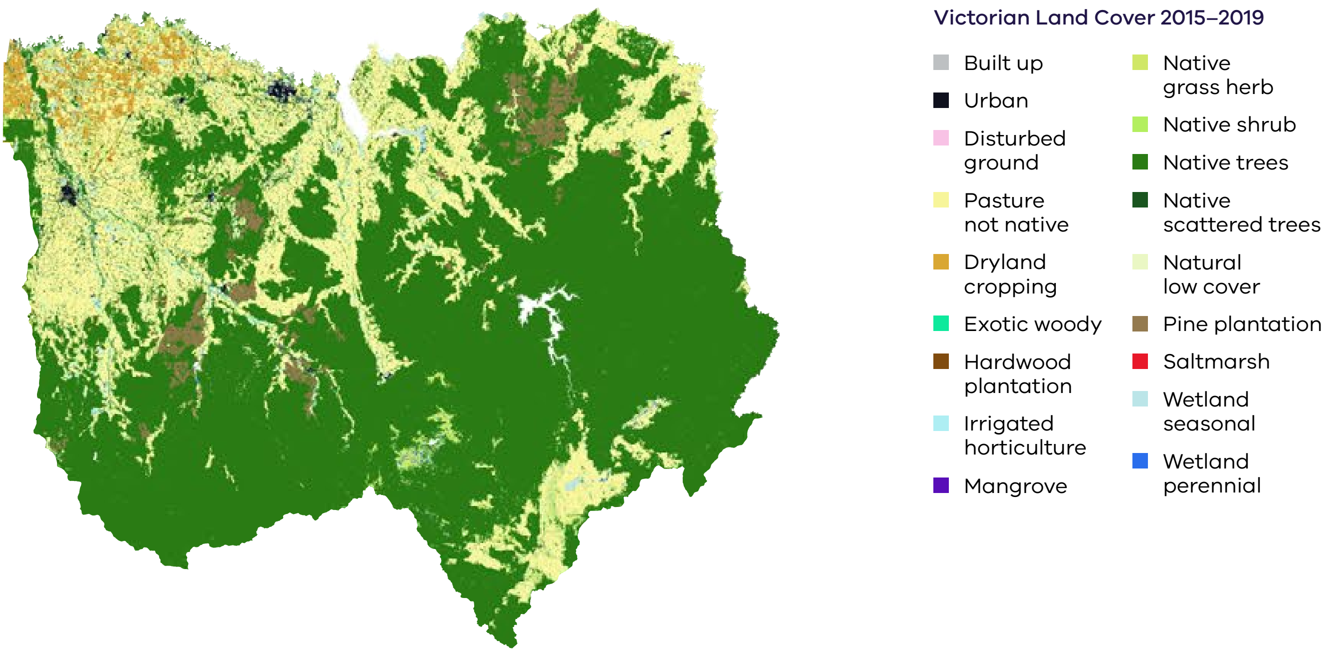


Figure 64. Victorian Land Cover Time Series (2015–2019) for the North East Region.

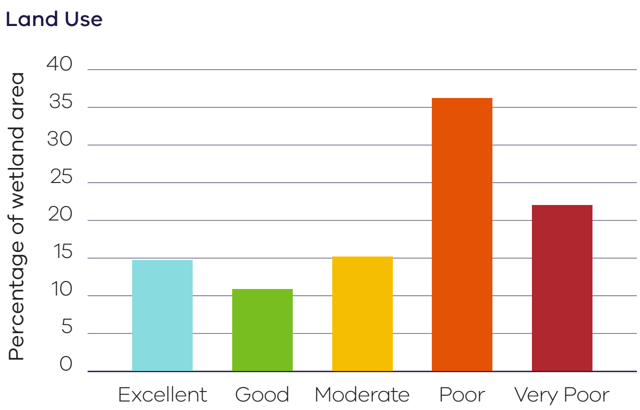


Figure 65. The percentage of wetland area in each condition score class in the North East Region for the land use sub-index.

4.8 Port Phillip and Western Port

The Port Phillip and Western Port region contains over 1800 inland, natural wetlands covering around 5000 hectares. These wetlands are distributed among six river basins: the Bunyip River, Maribyrnong River, Moorabool River, South Gippsland, Werribee River and Yarra River basins.

The vast majority of wetlands in the region are freshwater (> 98%), and most are temporary (80%), holding water for only part of the time. The region is characterised by small wetlands (average size of 2.4 hectares), with only three wetlands > 100 hectares and a maximum size of just over 250 hectares (Tootgarook Swamp). This is largely due to historical land use changes in the region, which supports the largest population (5 million) and urban area (14%) of any Region in Victoria as well as significant agricultural land uses. Many of the region's wetlands have been modified for urban settlement and agriculture. For example, the draining of Koo Wee Rup Swamp from the late 1800s to the early 1900s which converted around 40,000 hectares of paperbark and grassland swamp to agricultural land, with several smaller wetlands remaining inside the original swamp footprint.

The region includes three Ramsar listed wetlands: Western Port, Port Phillip (Western Shoreline) and Bellarine Peninsula, and Edithvale-Seaford Wetlands. While Western Port comprises mostly coastal, estuarine and marine wetland types, which are not included in the Victorian Wetland Condition Assessment, the other two Ramsar sites contain inland wetland systems which have been assessed. There are several threatened wetland communities in the region, including the EPBC listed seasonal herbaceous wetlands.

The wetlands of the Port Phillip and Western Port region support a diversity of inundation dependant plants and animals. The wetlands of the region are important for supporting populations of several nationally listed species including Australasian bittern (*Botaurus poiciloptilus*), orange-bellied parrot (*Neophema chrysogaster*), growling grass frog (*Litoria raniformas*) and striped legless lizard (*Delma impar*).

4.8.1 Port Phillip and Western Port Region Scores

The 2025 Victorian Wetland Condition Assessment found that only around a quarter of wetland area is in good or excellent condition, around half of the wetland area in the region is in moderate condition (48%), and a quarter in poor condition (Figure 66). This pattern of most wetland area in moderate to poor condition, 20 – 30% is similar across the river basins in the region (Table 35). The higher percentage of wetland area in the Maribyrnong in good condition and the Moorabool River Basin in moderate condition is influenced by a small number (two in each basin) of larger, unnamed wetlands on public land that comprise one third to one half of the total inland, natural wetland area in their respective basins.

In the Port Phillip and Western Port region, 8% of wetland area was in excellent condition, 15% was in good condition, 48% in moderate condition 26% in poor condition and 3% in very poor condition.

Over 80% of wetland area is on private land in the Port Phillip and Western Port region (see Text Box 11). The percentage of wetland area in excellent and good condition was higher for wetlands on public land (34% and 35% respectively) compared to private land (3% and 10%). There was a corresponding higher percentage of wetland area in poor and very poor condition on private land than public (Table 36).

Overall condition

Figure 66. The percentage of wetland area in each overall condition score class in the Port Phillip and Western Port region. The area is the combined area of mapped, inland wetlands that are not classified as dams.

Table 35. The percentage of wetland area in each overall condition score class for River Basins in the Port Phillip and Western Port region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

River Basin	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Bunyip River	1297	550	11	8	34	45	3
Maribyrnong River	169	75	2	53	37	8	0
Moorabool River	1223	195	1	13	67	15	4
South Gippsland	76	57	2	9	35	38	16
Werribee River	1005	327	1	14	57	26	2
Yarra River	876	522	4	18	50	26	2

Table 36. The percentage of wetland area in each overall condition score class for wetlands on public and private land in the Port Phillip and Western Port region. The area is the combined area of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Private	4143	1556	3	10	54	29	3
Public	897	257	34	35	22	9	0

Wetlands on private land

Three quarters of Victorian wetlands are on private land, and they represent about 35% of the wetland area. In the Port Phillip and Western Port region, however, over 80% of wetland area is on private land, with only a small wetland extent (< 900 hectares) in public reserves.

In general, wetlands on public land are in better condition than those on private land. There are many threats to wetlands across all land tenures, but as wetlands in reserves are largely managed for conservation and natural values, with many activities not permitted, the level of threat is usually lower than on private land. Threats that are more common to wetlands on private land include cropping in the wetland beds, stock access, drainage and vehicles traversing wetlands. Urban development is also a key driver of wetland degradation and loss particularly in the Port Phillip and Western Port region.

Unlike other waterways, wetlands on private land are generally excluded from being defined as a waterway under the *Water Act 1989*. This means that unlike rivers and streams, which are afforded some protection under the Act, waterway managers have very limited ability to manage or regulate activities impacting wetlands on private land. The ability to influence land use and development affecting wetlands is largely enabled via Victoria's Planning Provisions. Wetlands on private land are considered in land use planning processes through flood overlays, environmental significance overlays and native vegetation Regulations. The planning system's Farming Zone also requires a permit for earthworks that change the rate of flow or discharge point of water across a property boundary, which will often occur when a wetland is drained or filled. These planning provisions are largely administered by local government as the responsible authority for administering their planning schemes.

The Victorian Government invests in collaborations between waterway managers, landholders and other partners to undertake on-ground management activities and encourage good wetland management practices in priority areas (as identified by regional waterway strategies). This work is undertaken through voluntary agreements and co-operative partnerships.

Developing options to better incorporate wetlands on private land into the waterway management framework is a priority of the Victorian Waterway Management Program.

Text Box 11. Wetlands on private land.

Wetland landscape profiles were identified for the IWC and divide the state into regions based on elevation, rainfall and geomorphology. These have been used in this assessment to represent area-weighted average wetland condition spatially. In the Port Phillip and Western Port Region average wetland condition in wetland landscape profiles ranged from excellent to poor (Figure 67). There were small wetland landscape areas, including French Island, where wetland condition was on average excellent. The wetlands of the lower montane foothills-wet forest of the upper Yarra and Werribee catchments were, on average, in good condition. The wetlands in the largely urban landscapes around the north and west of Melbourne, as well as parts of the Mornington Peninsula, were on average in moderate condition. Several lowland grassy plains wetland landscapes were on average in poor condition including the area around Avalon, the eastern suburbs of greater Melbourne, the southern portion of the Mornington Peninsula and the south east of Western Port Bay.

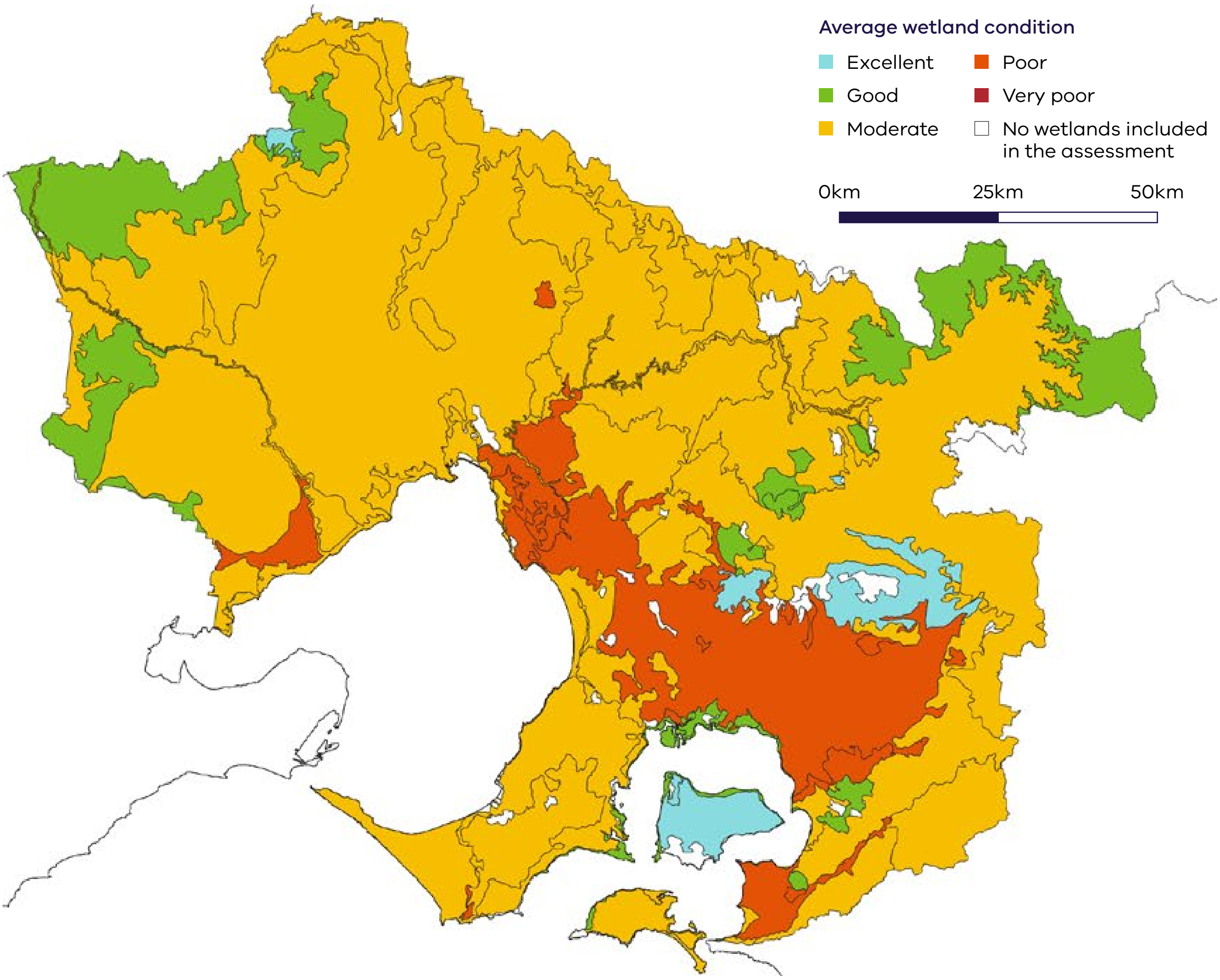


Figure 67. Area weighted wetland condition for Victorian Wetland Landscape Profiles in the Port Phillip and Western Port region.

Table 37. Area-weighted average condition scores based on VWI wetland type in the Port Phillip and Western Port Region. Sub-indices are scored out of 10 and the total score is out of a maximum possible of 50. The four hydrological metrics are shown separately: Magnitude of inundation, duration of inundation, frequency of inundation and the proportion of time a wetland is dry. These are combined into a single overall hydrological score before the final total scores are calculated.

			Hydrology metrics								
Wetland type	Area (ha)	No.	Magnitude	Duration	Frequency	Dry Fraction	Average Hydro.	Soil	Vegetation	Land Use	Total score
Peatlands	18	4	9	9	9	8	9	10	10	10	47
Permanent freshwater lake	154	17	8	8	7	8	7	8	9	4	32
Permanent freshwater marsh or meadow	17	7	7	7	6	9	7	10	7	3	29
Permanent freshwater swamp	56	53	7	7	8	8	7	9	9	5	35
Permanent paperbark swamp	2	2	8	6	8	8	8	9	10	2	30
Permanent river red gum swamp	5	2	10	8	8	7	8	10	10	2	32
Permanent saline lake	63	1	10	8	10	8	9	10	10	2	33
Permanent salt marsh	1	2	9	9	9	8	9	6	10	7	36
Permanent shallow wetland/ claypan	102	18	8	8	8	8	8	10	7	5	34
Permanent shrub swamp	4	2	10	7	9	10	9	10	8	3	32
Temporary freshwater lake	454	93	6	7	7	7	7	9	8	3	29
Temporary freshwater marsh or meadow	1257	248	7	7	8	8	7	8	10	3	31
Temporary freshwater swamp	757	584	7	8	8	8	8	8	8	4	32
Temporary lignum swamp	4	1	4	4	6	10	6	10	10	4	32
Temporary paperbark swamp	407	42	6	6	8	9	7	6	9	2	27
Temporary river red gum swamp	18	5	6	6	8	10	7	6	10	4	30
Temporary saline swamp	3	2	6	7	8	10	8	7	10	3	28
Temporary salt marsh	31	13	6	7	8	8	7	8	9	5	33
Temporary shallow wetland/claypan	1328	619	8	8	8	8	8	8	8	3	31
Temporary shrub swamp	359	98	8	8	8	8	8	9	10	9	44

4.8.2 Hydrology

The majority of wetlands in the Port Phillip and Western Port region have moderate amounts of modification to their hydrological regimes since the mid-1980s with around two thirds of wetland area classified as excellent or good with respect to the magnitude, duration and frequency of inundation (Figure 68). Altered hydrology in this region was characterised by both increases and decreases in inundation metrics, with over half of the wetland area experiencing greater inundation frequency, duration and / or magnitude. This is a stark contrast to most of the rest of the state, where wetlands overwhelmingly have been impacted by decreases in inundation and reflects the highly urbanised landscapes of the Port Phillip and Western Port region. There has been, however, little change in the proportion of time a wetland is completely dry for over 90% of wetlands. Wetlands that scored moderate, poor or very poor for hydrology included examples of all wetland types, but temporary wetlands have been more impacted by altered hydrology, then permanent wetlands (Table 37).

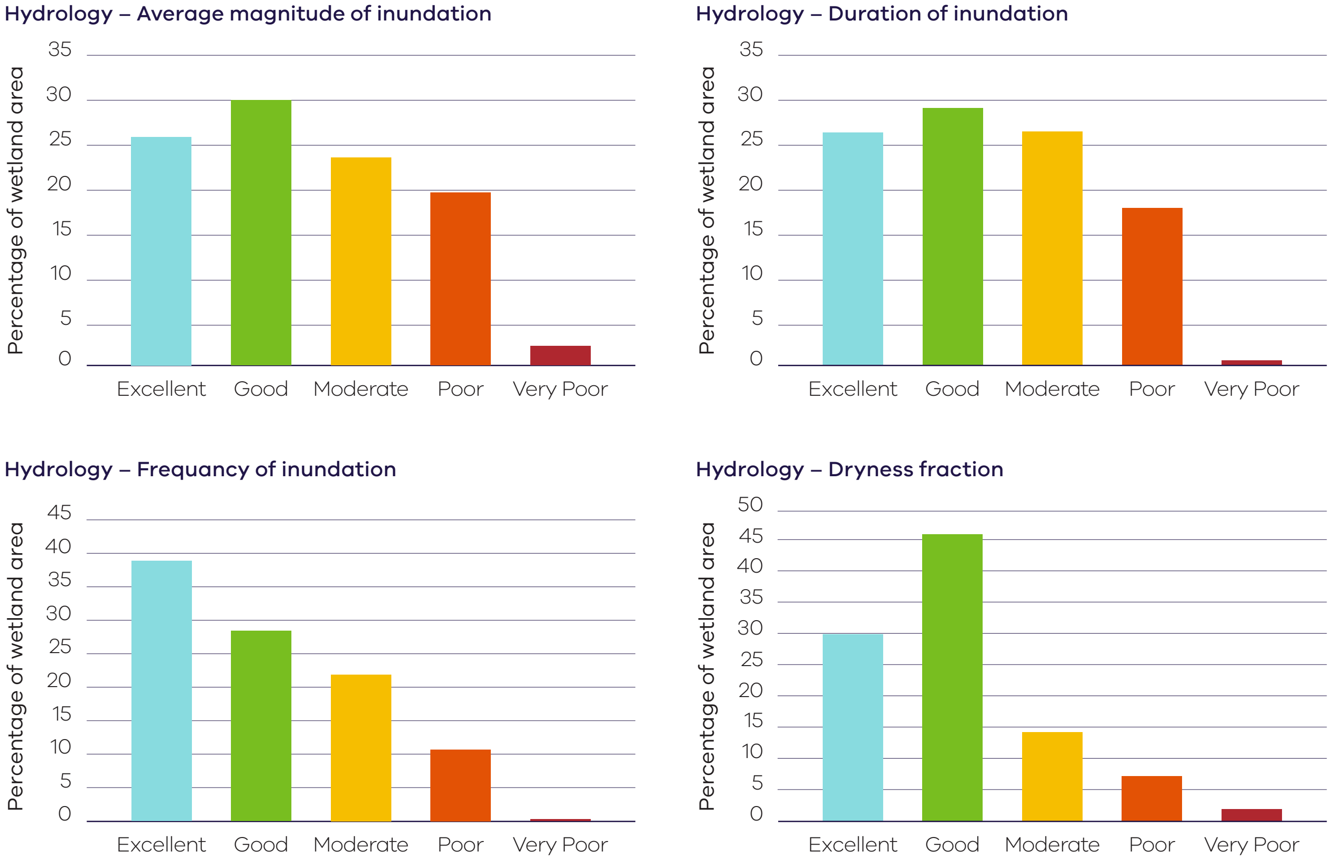


Figure 68. The percent of wetland area in each condition score class in the Port Phillip and Western Port region for average magnitude of inundation (top left) and duration of inundation (top right), frequency of inundation (bottom left) and proportion of time a wetland is dry (bottom right).

4.8.3 Soils

Over 75% of wetland area in the Port Phillip and Western Port region scored excellent or good for soils, indicating only small changes in the area of exposed soil since the 1980s (Figure 69). Wetlands that scored poor or very poor for this sub-index were largely small, temporary marshes and meadows or shallow wetlands / claypans on private property.

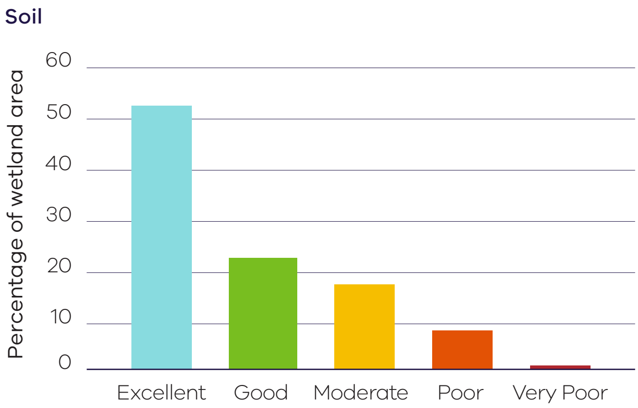


Figure 69. The percentage of wetland area in each condition score class in the Port Phillip and Western Port region for the soil sub-index.

4.8.4 Vegetation

Vegetation was in excellent or good condition for over 80% of wetland area (Figure 70). The small amount of wetland area in moderate, poor and very poor condition with respect to vegetation was mostly small, temporary marshes and meadows or shallow wetlands / claypans on private property.

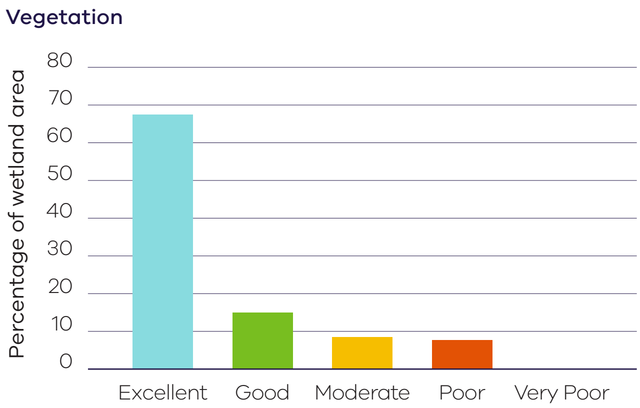


Figure 70. The percentage of wetland area in each condition score class in the Port Phillip and Western Port region for the vegetation sub-index.

4.8.5 Land use

The Port Phillip and Western Port region contains the largest urban and built areas of Victoria including Greater Melbourne. This combined with intensive agriculture in low lying areas resulted in 80% of wetland area scoring poor or very poor for this sub-index (Figure 71 and Figure 72). Wetlands that score excellent and good were within conservation reserves or in montane upper catchments surrounded by native vegetation.

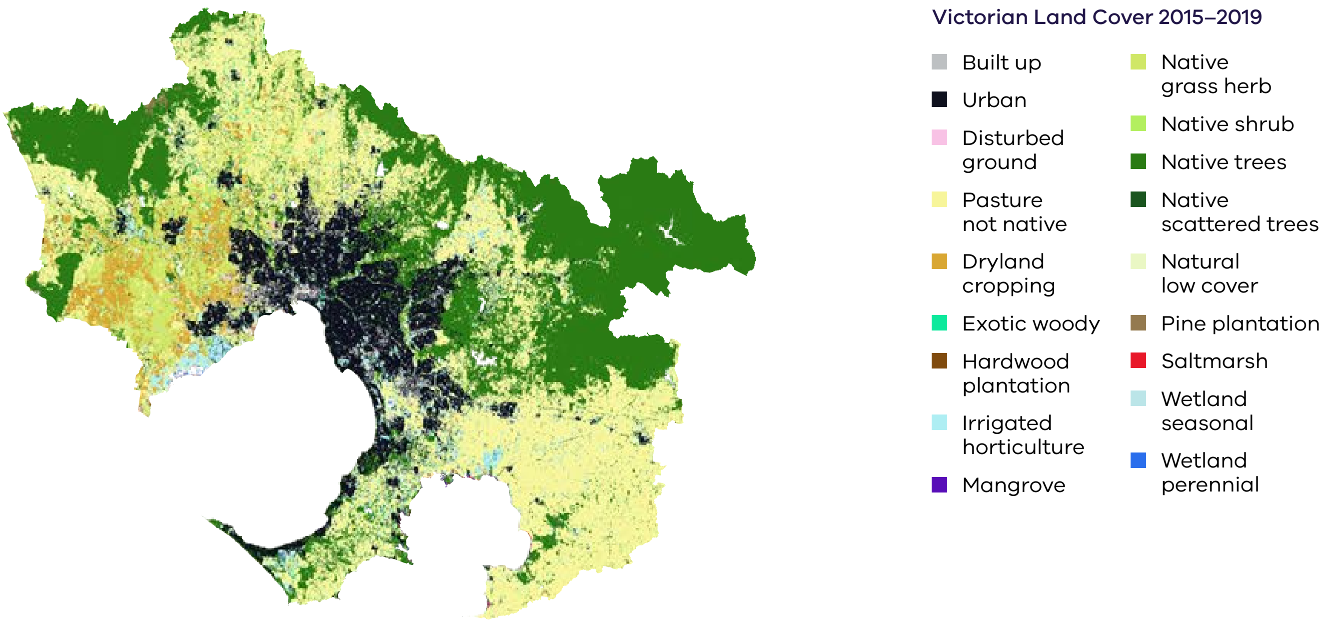


Figure 71. Victorian Land Cover Time Series (2015–2019) for the Port Phillip and Western Port region.

Figure 72. The percentage of wetland area in each condition score class in the Port Phillip and Western Port region for the land use sub-index.

4.9 West Gippsland

The West Gippsland region contains over 3600 inland, natural wetlands covering an area of approximately 40,000 hectares. These wetlands are distributed among three river basins: the Latrobe River, South Gippsland and Thomson River basins.

The region includes parts of the Gippsland Lakes Ramsar site, including Lake Wellington, a large, permanent wetland that covers nearly 15,000 hectares, representing over one third of the inland wetland area of the region. For this reason, Lake Wellington was not included in the assessment as it would overly influence area averaged results. It is also permanently connected to the marine environment via McLennan Strait and Lake Victoria.

The wetlands of West Gippsland support a diversity of plants and animals. Freshwater wetlands such as Sale Common and those within the Bald Hills State Wildlife Reserve act as important drought refuges in a region with few freshwater wetlands on public land. Notable species include international migratory shorebirds, EPBC listed growling grass frog (*Litoria raniformis*) and green and golden bell frog (*Litoria aurea*), Australasian bittern (*Botaurus poiciloptilus*).

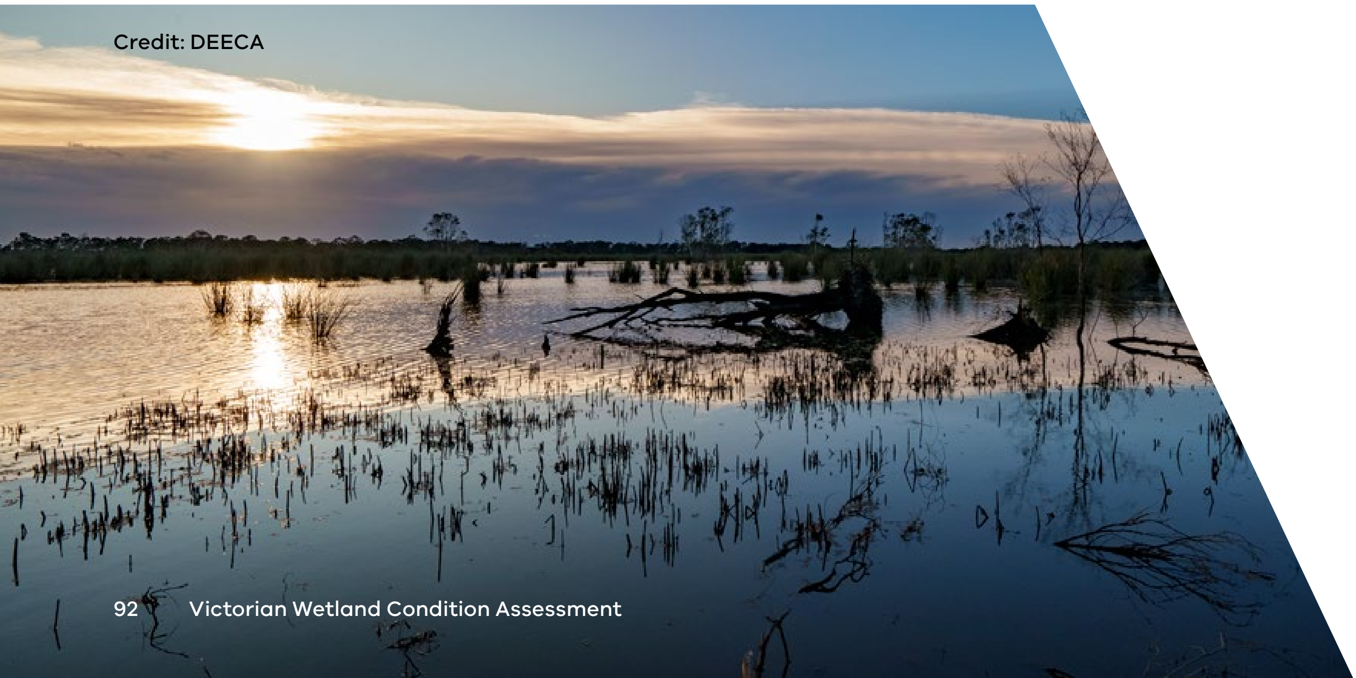
4.9.1 West Gippsland Region Scores

The 2025 Victorian Wetland Condition Assessment found that three quarters of inland, natural wetland area in West Gippsland was in excellent or good condition and just 5% in poor condition (Figure 73). This was reflected in each of the river basins in the region, which also had 70 – 80% of wetland area in excellent or good condition, around 20% in moderate condition and small proportions in poor or very poor condition (Table 38).

In the West Gippsland Region, 46% of wetland area was in excellent condition, 30% was in good condition, 19% in moderate condition and 5% in poor condition.

The percentage of wetland area in excellent condition was higher for wetlands on public land (73%) compared to private land (16%). Almost all wetland area on public land (97%) was in excellent or good condition compared to just over half the wetland area (53%) on private land (Table 39). Around a third of wetland area on private land was in moderate condition and 11% in poor or very poor condition.

Figure 73. The percentage of wetland area in each overall condition score class in the West Gippsland region. The area is the combined area of mapped, inland wetlands that are not classified as dams, excluding Lake Wellington.



Credit: DEECA

Table 38. The percentage of wetland area in each overall condition score class for River Basins in the West Gippsland region. The area is the combined area of mapped, inland wetlands that are not classified as dams, excluding Lake Wellington. "No." is the number of wetlands assessed.

River Basin	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Latrobe River	11991	1163	66	14	16	3	<1
South Gippsland	3399	635	52	21	16	8	2
Thomson River	9867	1775	19	51	23	7	<1

Table 39. The percentage of wetland area in each overall condition score class for wetlands on public and private land in the West Gippsland region. The area is the combined area of mapped, inland wetlands that are not classified as dams, excluding Lake Wellington. "No." is the number of wetlands assessed.

	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Private	11964	2522	16	37	36	10	1
Public	13693	1120	73	23	3	<1	<1

Wetland landscape profiles were identified for the IWC and divide the state into regions based on elevation, rainfall and geomorphology (see Appendix A). These have been used in this assessment to represent area-weighted average wetland condition spatially. Wetlands in the northern hills and alpine landscapes together with those adjacent to the coast were in good to excellent condition on average. Wetlands of the mid to upper Latrobe and Thomson Rivers in lowland sandy heath and lowland grassy plains were, on average, in moderate condition (Figure 74). There are pockets where wetlands were, on average, in poor condition, including the lowland riparian floodplain of the Tarwin River and to the north of Corner Inlet.

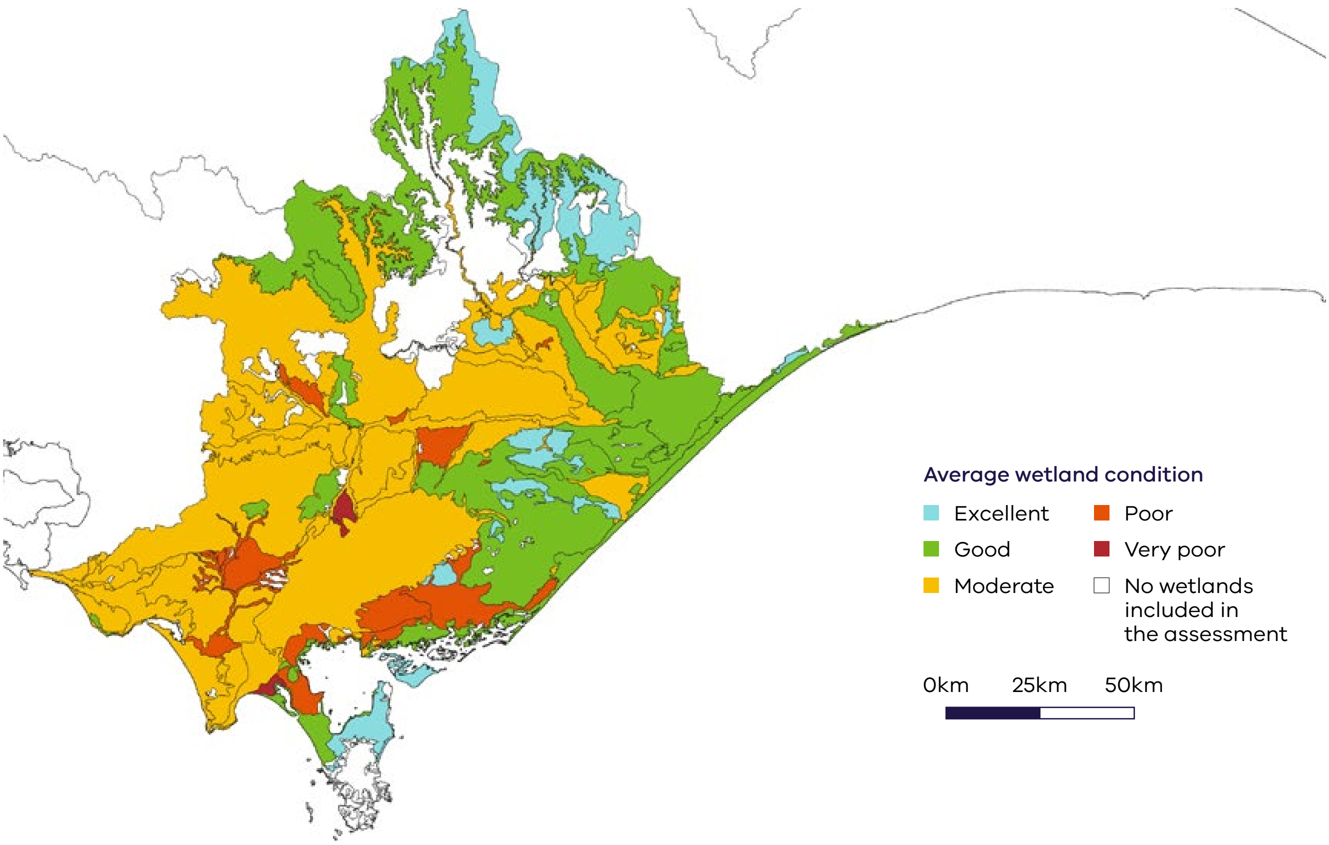


Figure 74. Area weighted wetland condition for Victorian Wetland Landscape Profiles in the West Gippsland region. Note that although the coastal regions of Corner Inlet form part of the near coastal wetland landscape profiles, no marine or estuarine wetlands were included in the assessment of wetland condition.

Table 40. Area-weighted average condition scores based on VWI wetland type in the West Gippsland Region. Sub-indices are scored out of 10 and the total score is out of a maximum possible of 50. The four hydrological metrics are shown separately: Magnitude of inundation, duration of inundation, frequency of inundation and the proportion of time a wetland is dry. These are combined into a single overall hydrological score before the final total scores are calculated.

			Hydrology metrics								
Wetland type	Area (ha)	No.	Magnitude	Duration	Frequency	Dry Fraction	Average Hydro.	Soil	Vegetation	Land Use	Total score
Peatlands	956	646	8	8	9	7	8	8	10	10	42
Permanent freshwater lake	279	34	8	9	8	7	8	10	8	6	37
Permanent freshwater marsh or meadow	328	37	9	10	7	8	8	10	5	5	31
Permanent freshwater swamp	283	47	8	8	8	8	8	9	8	6	36
Permanent paperbark swamp	294	5	8	10	6	8	8	10	6	8	37
Permanent saline lake	799	10	8	8	6	8	7	10	7	9	39
Permanent saline wetland	10191	8	8	9	9	7	8	10	7	9	41
Permanent salt marsh	1423	29	8	9	9	7	8	10	8	9	42
Permanent shallow wetland/claypan	90	26	8	8	8	8	8	10	8	5	35
Permanent shrub swamp	52	7	7	8	8	8	8	10	8	9	42
Temporary freshwater lake	946	143	7	8	8	8	8	9	9	5	34
Temporary freshwater marsh or meadow	1296	350	8	8	8	7	8	10	9	6	37
Temporary freshwater swamp	1398	833	8	8	8	8	8	9	9	4	34
Temporary paperbark swamp	630	81	8	8	9	9	8	9	6	6	34
Temporary saline lake	410	9	8	8	8	10	8	10	10	5	37
Temporary saline swamp	672	27	8	8	8	8	8	10	8	9	42
Temporary salt marsh	1619	43	7	7	7	9	7	10	7	6	36
Temporary shallow wetland/claypan	1781	1006	8	8	8	8	8	9	8	4	33
Temporary shrub swamp	1915	299	8	8	8	8	8	10	10	9	43
Temporary Tall Marsh	295	2	10	8	10	4	8	10	4	6	30

4.9.2 Hydrology

The majority of wetland area in the West Gippsland Region scored "excellent" or "good" with respect to hydrology indicating little change in these indicators since the late 1980s (Figure 75). This is reflected in the assessment of wetland types in the West Gippsland Region (Table 40), where most wetland types were assessed as having good hydrology. Wetland areas that scored poor or very poor for hydrology included a number of small peatlands, which had increased periods of dryness; several freshwater lakes and swamps in the Thomson and Latrobe Basins that had reduced magnitude, and frequency of inundation.

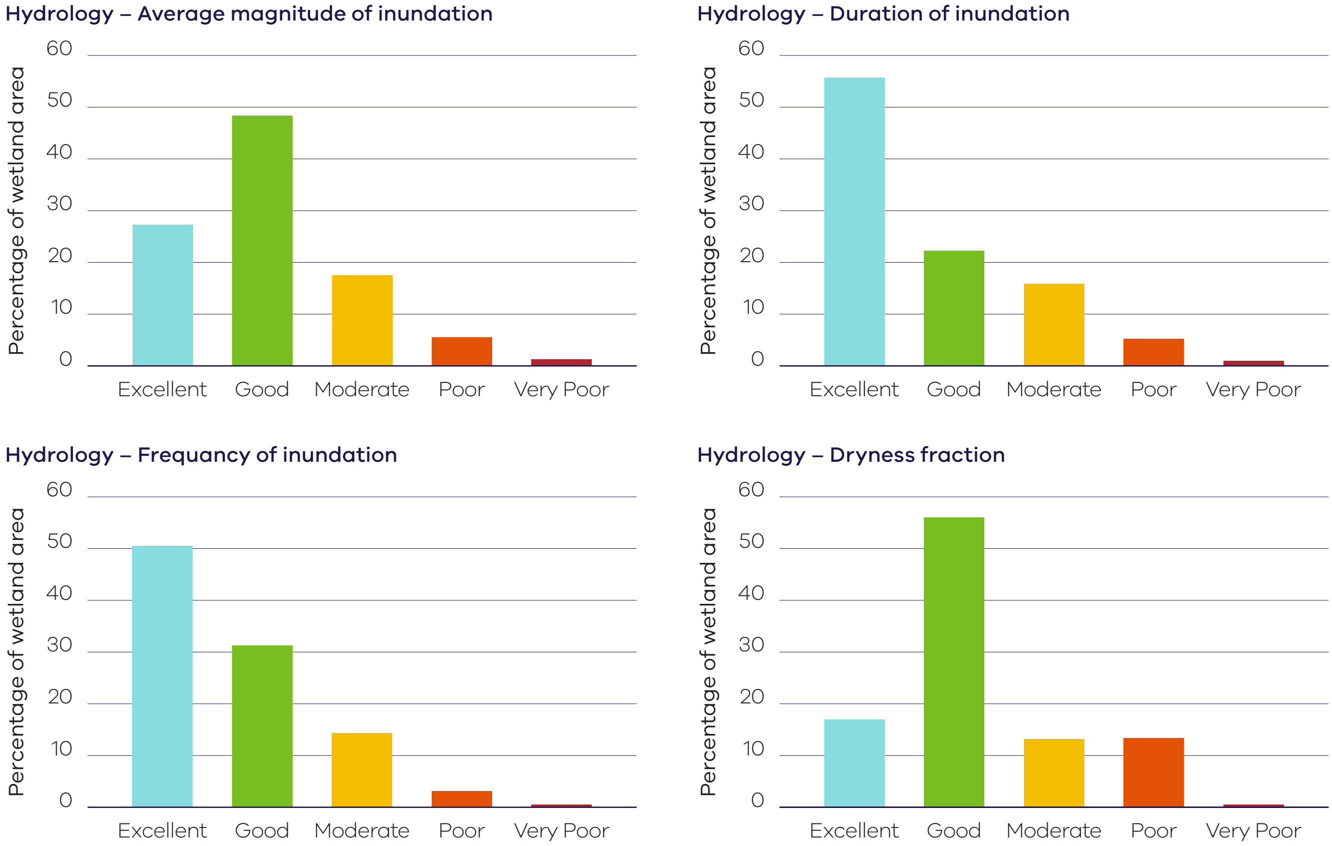


Figure 75. The percentage of wetland area in each condition score class in the West Gippsland Region for average magnitude of inundation (top left) and duration of inundation (top right), frequency of inundation (bottom left) and proportion of time a wetland is dry (bottom right).

4.9.3 Soils

The majority of wetland area in the West Gippsland Region scored excellent for soils, indicating no change in exposed soil from the late 1980s to current (Figure 76). The small number that scored poor or very poor comprised of a variety of wetland types but included a number of peatlands, and small freshwater swamps and paperbark swamps.

4.9.4 Vegetation

The condition of vegetation varied from very poor to excellent among wetlands of the West Gippsland region, however over half of the wetland area had good or excellent vegetation. Vegetation was in excellent condition across 46% of wetland area and good at 6% (Figure 77). The wetlands that scored poor or very poor again included a number of small peatlands and a range of temporary freshwater marsh or meadows and paperbark swamps.

Figure 76. The percentage of wetland area in each condition score class in the West Gippsland Region for the soil sub-index.

Figure 77. The percentage of wetland area in each condition score class in the West Gippsland Region for the vegetation sub-index.

4.9.5 Land use

Over half the West Gippsland region retains native vegetation and aquatic habitats, with much of the remaining area supporting pasture and grazing (Figure 78). Almost half the wetland area in West Gippsland had high proportions of native vegetation within one kilometre, scoring excellent (Figure 79). There were around 16% of wetlands that scored moderate for land use, 10% that scored poor and 9% that score very poor. These low scoring wetland areas were all in lowland regions on the Gippsland Plain. Wetland types in these higher intensity land uses were commonly temporary shallow wetland/claypans, and freshwater sedge/grass marsh or meadows.

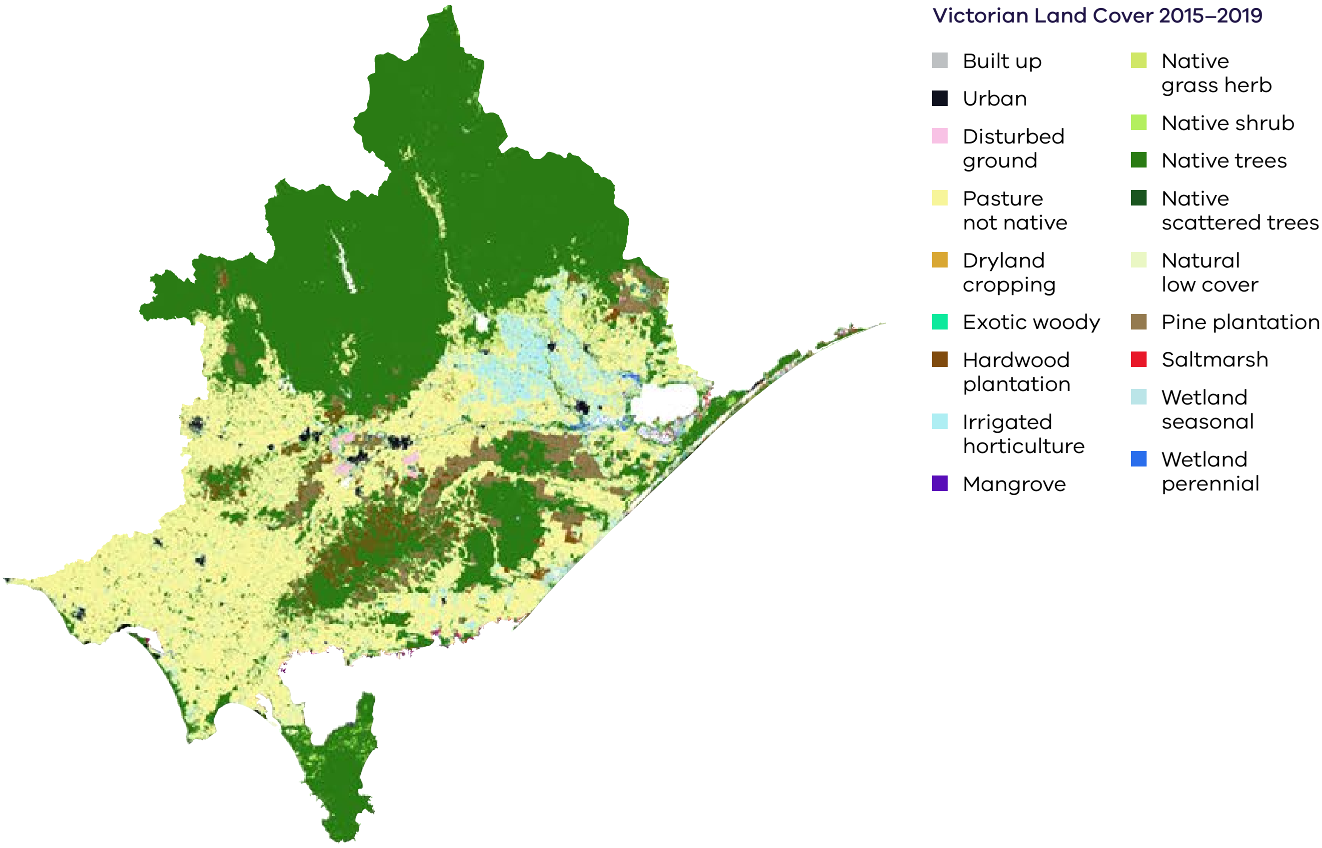


Figure 78. Victorian Land Cover Time Series (2015–2019) for West Gippsland.

Figure 79. The percentage of wetland area in each condition score class in the West Gippsland Region for the land use sub-index.

4.10 Wimmera

The Wimmera region has over 3400 natural wetlands covering an area of over 75,000 hectares. This represents about a quarter of the depressional (not linked to rivers or streams) wetlands in Victoria. These wetlands are distributed among two river basins: the Millicent Coast and Wimmera-Avon River basins.

The region includes Lake Hindmarsh, a temporary freshwater lake which has a surface area of around 14,000 hectares, representing 20% of the wetland area in the region. For this reason, Lake Hindmarsh was not included in the assessment as it would overly influence area averaged scores.

Lake Albacutya is recognised as a wetland of international importance under the Ramsar Convention. This terminal lake receives water only during very large flood events but can hold water for several years following inundation. The Wimmera region also contains a number of nationally important wetlands including Lake Hindmarsh, Pink Lake, Oliver's Swamp, Natimuk Lake, Mitre Lake, Grass Flat Swamp, White Lake and Heard's Lake. These important wetlands represent a diversity of wetland types including salt lakes, permanent and temporary freshwater lakes and inland saltmarsh.

The Wimmera's wetlands support many plants and animals of national significance. The Wimmera is home to many Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains which are listed as a critically endangered ecological community nationally (EPBC). Australian nomadic birds are known to frequent the region to breed, and the endangered regent parrot (*Polytelis anthopeplus*) inhabits the surrounds of Lakes Albacutya and Hindmarsh. Wetlands also play an important role in supporting waterbirds such as the plumed whistling duck (*Dendrocygna eytoni*) when there is drought in other parts of the country.

4.10.1 Wimmera Region Scores

The 2025 Victorian Wetland Condition Assessment found that around one quarter of natural wetland area in the Wimmera region was in excellent or good condition and over 40% in poor or very poor condition. (Figure 80). This pattern generally holds true for wetlands in both the Millicent Coast and Wimmera-Avon Basins (Table 41). There was, however, a higher percentage of wetland area in good condition in the Wimmera-Avon Basin (31%) compared to the Millicent Coast (10%). This is largely due to the influence of Lake Albacutya on area-weighted averages in the Wimmera-Avon Basin as this wetland comprises around 25% of the total wetland area in that Basin. Although Lake Albacutya was assessed as overall being in "good" condition, this is due to the fact that three of the sub-indices (hydrology, soil and vegetation) assess condition as departure from baselines spanning from the 1980s. Lake Albacutya has remained dry since that time and so does not show as having altered threat or condition metrics.

> In the Wimmera Region, 3% of wetland area was in excellent condition, 21% was in good condition, 32% in moderate condition 39% in poor condition and 4% in very poor condition.

Around 14% of wetland numbers and 37% of wetland area is on public land in the Wimmera and these wetlands were generally in better condition than those on private property (Table 42). The proportion of wetland area in excellent and good condition on public land was 3% and 31% respectively, compared to 3% and 10% on private property. Over half the wetland area on private property were in poor or very poor condition.

Figure 80. The percentage of wetland area in each overall condition score class in the Wimmera region. The area is the combined area of mapped, inland wetlands that are not classified as dams (excluding Lake Hindmarsh).

Table 41. The percentage of wetland area in each overall condition score class for River Basins in the Wimmera region. The area is the combined area of mapped, inland wetlands that are not classified as dams (excluding Lake Hindmarsh). "No." is the number of wetlands assessed.

River Basin	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Millicent Coast	29813	2126	3	10	39	43	6
Wimmera-Avon Rivers	30498	1283	3	31	27	35	3

Table 42. The percentage of wetland area in each overall condition score class for wetlands on public and private land in the Wimmera region. The area is the combined area of mapped, inland wetlands that are not classified as dams, excluding Lake Hindmarsh. "No." is the number of wetlands assessed.

	Area (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Private	38197	2989	1	8	38	45	7
Public	22885	495	6	41	25	27	1

Wetland landscape profiles were identified for the IWC and divide the state into regions based on elevation, rainfall and geomorphology. These have been used in this assessment to represent area-weighted average wetland condition spatially (Figure 81). The wetlands of the "drier western hills and inland tablelands and slopes" landscapes within the Grampians were, on average, in excellent condition and the wetlands in the "lowland sandy health" landscape of the Little Desert National Park were in good condition. The wetlands in the remainder of the Wimmera were largely in moderate condition or poor condition on average.

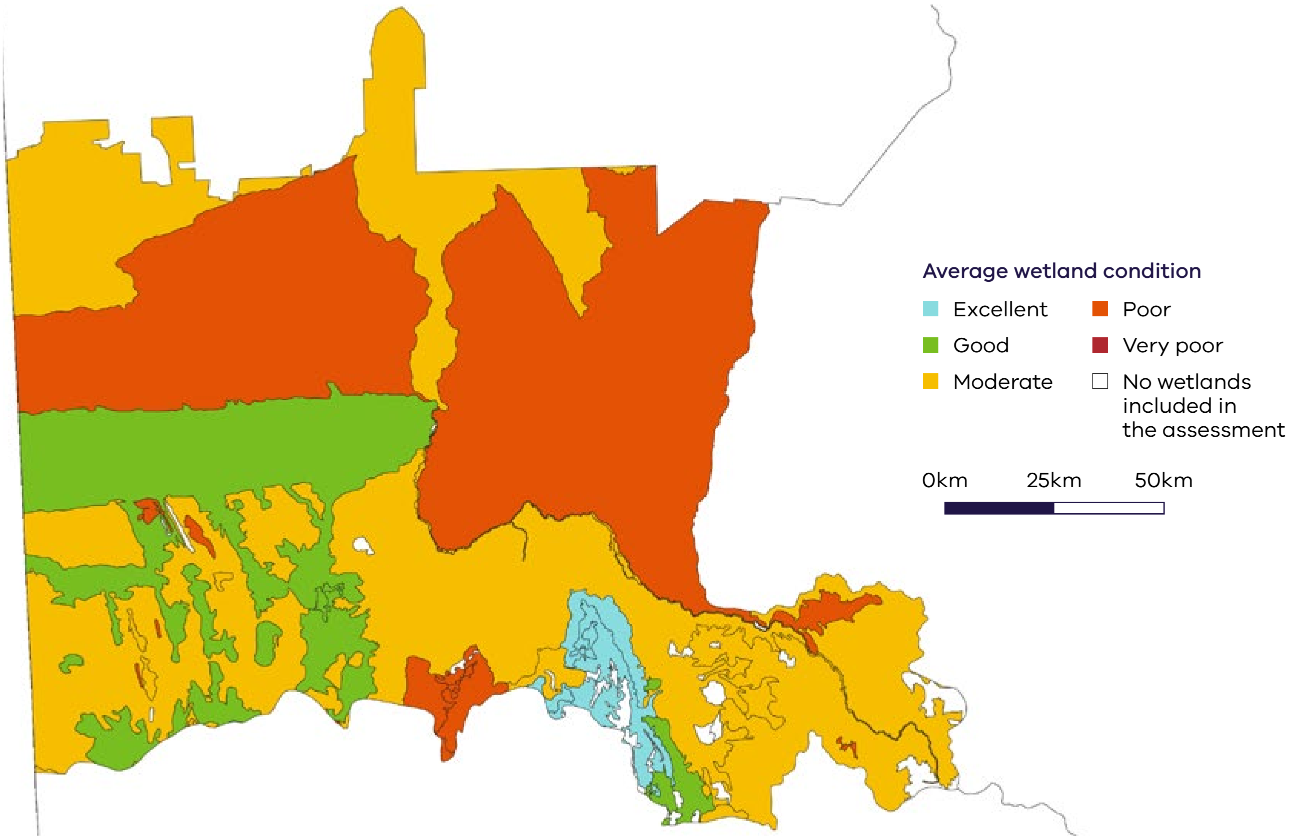


Figure 81. Area weighted wetland condition for Victorian Wetland Landscape Profiles in the Wimmera Region.

Table 43. Area-weighted average condition scores based on VWI wetland type in the Wimmera Region. Sub-indices are scored out of 10 and the total score is out of a maximum possible of 50. The four hydrological metrics are shown separately: Magnitude of inundation, duration of inundation, frequency of inundation and the proportion of time a wetland is dry. These are combined into a single overall hydrological score before the final total scores are calculated.

			Hydrology metrics								
Wetland type	Area (ha)	No.	Magnitude	Duration	Frequency	Dry Fraction	Average Hydro.	Soil	Vegetation	Land Use	Total score
Permanent freshwater lake	2903	26	6	5	7	8	7	7	10	5	32
Permanent freshwater marsh or meadow	5	1	10	8	8	10	9	10	8	4	34
Permanent freshwater swamp	21	1	8	8	8	8	8	10	10	8	43
Permanent river red gum swamp	49	2	6	4	4	8	6	5	10	2	22
Permanent saline lake	1220	10	4	4	7	8	6	7	10	3	27
Permanent saline wetland	168	5	4	4	6	8	6	8	10	4	29
Permanent salt marsh	1254	3	6	7	7	9	7	6	10	2	26
Permanent shallow wetland/claypan	163	5	6	4	7	10	7	7	10	5	32
Temporary black box swamp	33	2	10	10	6	8	9	9	8	4	32
Temporary freshwater lake	13448	217	4	4	5	7	5	8	10	5	31
Temporary freshwater marsh or meadow	3114	200	5	5	6	8	6	7	9	4	30
Temporary freshwater swamp	1102	198	7	7	7	8	7	8	8	5	31
Temporary lignum swamp	3595	218	5	6	7	7	6	7	8	3	26
Temporary paperbark swamp	2	3	5	4	5	7	5	7	7	4	27
Temporary river red gum swamp	21507	1808	6	6	7	8	7	6	8	4	29
Temporary saline lake	1423	71	5	5	5	8	6	7	10	4	29
Temporary saline swamp	1660	80	6	6	7	7	7	7	9	3	28
Temporary salt marsh	298	19	5	6	7	9	7	7	10	4	30
Temporary shallow wetland/claypan	7427	368	6	5	6	8	6	8	9	5	31
Temporary shrub swamp	1690	247	7	7	7	8	7	7	9	6	34

4.10.2 Hydrology

The majority of wetlands in the Wimmera Region have moderate to severe modifications to parts of their hydrological regimes since the 1980s. Over half of the wetland area was assessed as poor or very poor with respect to magnitude and frequency of inundation, with lesser impacts to duration and the period of time a wetland is completely dry (Figure 82). This is reflected in the assessment of wetland types in the Wimmera Region (Table 43), where most wetland types scored moderate or poor due to decreases in duration and frequency of inundation.

The hydrology sub-index is underpinned by data from 1988–2022. Since the end of 2022 some parts of Victoria have experienced very dry conditions (e.g., south-west Victoria, including the Wimmera Region), with reduced rainfall and record-breaking dry spells. As such, the Hydrology sub-index scores for the Wimmera region may underestimate levels of hydrological stress for the wetlands of this region at the time of this report (Text Box 8).

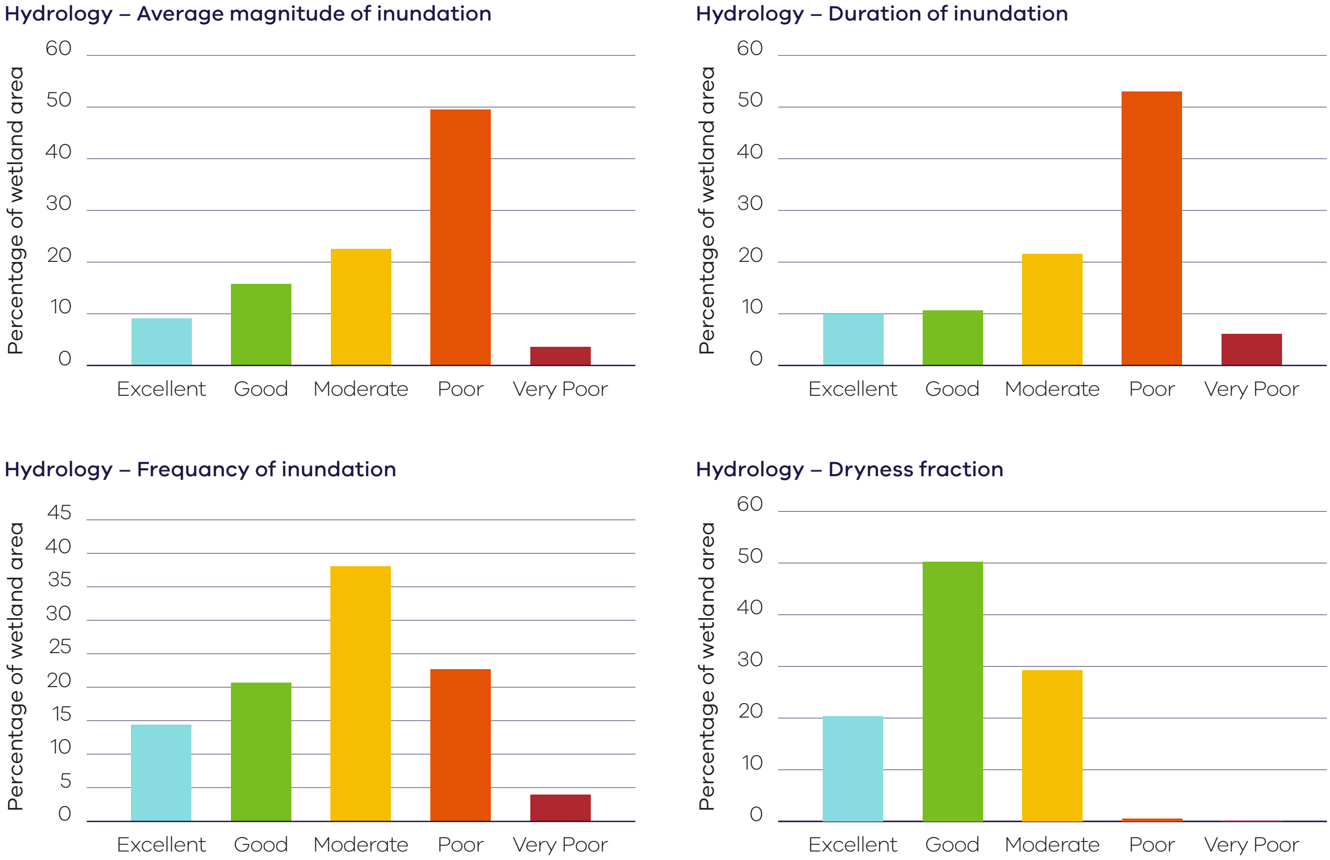


Figure 82. The percentage of wetland area in each condition score class in the Wimmera Region for average magnitude of inundation (top left) and duration of inundation (top right), frequency of inundation (bottom left) and proportion of time a wetland is dry (bottom right).

4.10.3 Soils

Around two thirds of wetland area in the Wimmera region scored excellent or good for soils, indicating only small changes in the area of exposed soil since the 1980s (Figure 83). Those that scored poor or very poor were largely temporary river red gum swamps.

Figure 83. The percentage of wetland area in each condition score class in the Wimmera Region for the soil sub-index.

4.10.4 Vegetation

The condition of vegetation varied from very poor to excellent among wetlands of the Wimmera region, however the vast majority of wetland area had good or excellent vegetation. Vegetation was in excellent condition across 68% of wetland area and good at 17% (Figure 84). The small number of wetlands that scored moderate for this sub-index included temporary river red gum and temporary lignum swamps.

Figure 84. The percentage of wetland area in each condition score class in the Wimmera Region for the vegetation sub-index.

4.10.5 Land use

The Wimmera Region is dominated by agriculture, which covers around 80% of the region. This includes large areas of dryland cropping (Figure 85). Native vegetation has been retained in the regions large parks and reserves including Little Desert and the Grampians. Just 7% of wetlands are surrounded by low intensity land uses, scoring good or excellent (Figure 86). There were around 24% of wetlands that scored moderate for land use, 42% that scored poor and 27% that score very poor.

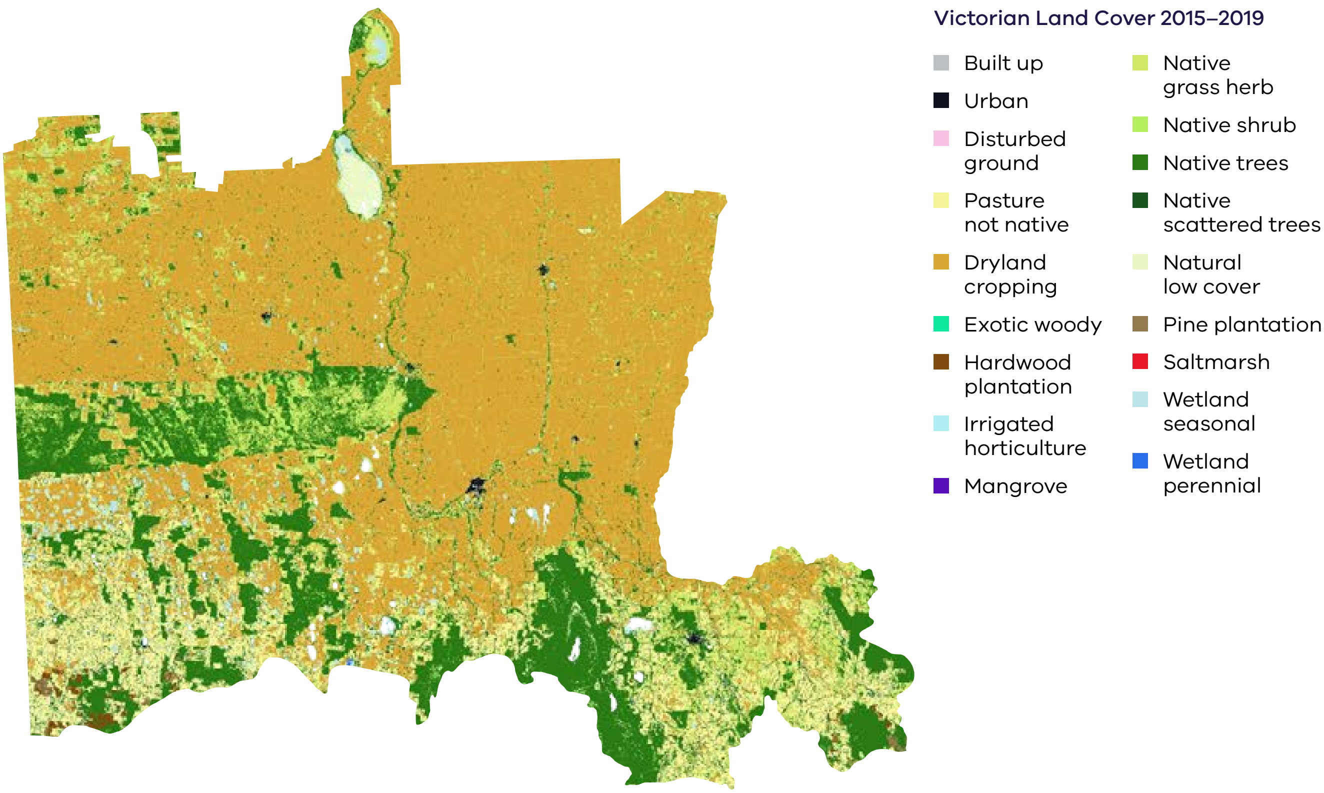


Figure 85. Victorian Land Cover Time Series (2015–2019) for the Wimmera Region.

Figure 86. The percentage of wetland area in each condition score class in the Wimmera Region for the land use sub-index.

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Appendix A: Victorian wetland landscape profiles

1. Alpine/sub-alpine:

Wetlands associated with higher mountain areas of eastern Victoria, within areas subject to sustained winter snow (generally above 1200 m elevation, but sometimes extending lower with cool air drainage).

2. Montane:

Wetlands associated with high elevation areas (generally within 700–1200 m elevation) of eastern Victoria below the sub-alpine zone. Subject to cold air drainage, but below the zone of sustained winter snow.

3. Lower montane to foothill/wet forest:

Wetlands of gullies and drainage lines within taller, denser forest country (e.g. East Gippsland, South Gippsland, Central Highlands and Otways).

4. Hills: foothills, inland slopes and hilly near-coastal:

Wetlands associated with drainage lines and wet flats of at least moderate rainfall foothill country (south of divide and moister inland slopes, generally >650 mm rainfall per annum).S

5. Drier hills and tablelands (mainly western) and northern slopes:

Wetlands associated with drainage lines, springs and soaks, swales and wet flats of lower rainfall hilly areas (specifically north-east hills, drier Midlands of north-central Victoria and the elevated plateau of the Dundas Tablelands, generally <650 mm rainfall per annum).

6. Lowland grassy plains – western volcanics:

Wetland systems associated with basaltic terrain of (southern) western to central Victoria.

7. Lowland grassy plains – riverina plains (sedimentary):

Wetland systems associated with sedimentary alluvial plains of northern Victoria (within the basin of the Murray River and tributaries, approximately east of Loddon River).

8. Lowland grassy plains – Wimmera (to southern Mallee):

Wetland systems associated with inland sedimentary alluvial plains of further western to north-western Victoria (approximately west of Loddon River).

9. Lowland grassy plains – coastal/southern plains:

Wetland systems associated with relatively fertile (mostly clay) sedimentary plains south of the Divide.

10. Lowland heathy/sandy:

Wetland systems associated with relatively less fertile (mostly acidic sandy) sedimentary soils (e.g. sand sheets and dune swales), mostly south of the Divide but extending inland in south-west Victoria (e.g. Grampians, Little Desert).

11. Mallee – non-riverine:

Wetlands associated with the Mallee country of further north-west Victoria.

12. Riverine – mid-Murray:

Wetlands associated with the riverine floodplain of the Murray River and tributaries (approximately upstream of Kerang).

13. Riverine – Mallee:

Wetlands associated with the riverine floodplain of the Murray River and tributaries (approximately downstream of Kerang).

14. Near coastal:

Wetlands associated with near-coastal situations (especially calcareous dune systems and blocked drainage lines) and including those with tidal or estuarine influences.

15. Lowland riparian floodplain:

Wetlands associated with floodplains of major streams outside of the Victorian Riverina.

16. Lacustrine:

Vegetation associated with lakes.

Appendix B: Wetland type results

Victoria (statewide)

Table 44. The percentage of wetland extent for each wetland type in each condition class for the wetland catchment sub-index. The extent is the combined extent of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

Wetland type	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Peatlands	4386	2521	89	11	<1	0	0
Permanent freshwater lake	30332	397	3	4	7	44	42
Permanent freshwater marsh or meadow	2663	169	20	13	28	36	3
Permanent freshwater swamp	1677	241	32	44	7	8	8
Permanent paperbark swamp	570	41	0	60	10	22	8
Permanent river red gum swamp	6775	131	41	2	3	53	1
Permanent saline lake	22172	177	3	1	5	53	38
Permanent saline wetland	12089	38	49	26	19	6	1
Permanent salt marsh	3559	59	42	10	10	2	37
Permanent shallow wetland/claypan	2378	189	14	27	7	41	11
Permanent shrub swamp	963	54	28	4	14	54	1
Permanent tall marsh	458	12	59	3	36	2	0
Temporary black box swamp	234	34	19	24	<1	43	14
Temporary freshwater lake	87976	2684	1	4	14	37	43
Temporary freshwater marsh or meadow	52859	5399	8	5	8	35	45
Temporary freshwater swamp	23902	5355	6	8	13	38	35
Temporary lignum swamp	25460	839	1	3	9	44	43
Temporary paperbark swamp	4621	566	3	9	19	23	45
Temporary river red gum swamp	71620	3713	29	20	9	31	11
Temporary saline lake	18377	466	6	3	9	52	30
Temporary saline swamp	7683	205	6	11	11	46	25
Temporary salt marsh	6476	212	4	10	11	63	12
Temporary shallow wetland/claypan	73181	7053	2	3	19	42	34
Temporary shrub swamp	26091	1869	44	15	15	16	10
Temporary Tall Marsh	1671	32	73	3	23	<1	0

Table 45. The percentage of wetland extent in each condition class for the hydrology sub-index (average across all four-hydrology metrics). The extent is the combined extent of mapped, inland wetlands that are not classified as dams. “No.” is the number of wetlands assessed.

Wetland type	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Peatlands	4386	2521	58	34	7	1	<1
Permanent freshwater lake	30332	397	38	35	17	7	1
Permanent freshwater marsh or meadow	2663	169	66	15	18	<1	0
Permanent freshwater swamp	1677	241	20	16	62	1	1
Permanent paperbark swamp	570	41	39	58	2	0	0
Permanent river red gum swamp	6775	131	25	23	1	0	51
Permanent saline lake	22172	177	6	17	47	15	10
Permanent saline wetland	12089	38	61	27	2	8	<1
Permanent salt marsh	3559	59	24	63	13	0	1
Permanent shallow wetland/claypan	2378	189	26	41	27	1	5
Permanent shrub swamp	963	54	19	16	11	53	0
Permanent tall marsh	458	12	6	3	90	1	0
Temporary black box swamp	234	34	57	13	27	3	0
Temporary freshwater lake	87976	2684	35	22	13	25	2
Temporary freshwater marsh or meadow	52859	5399	44	28	19	8	1
Temporary freshwater swamp	23902	5355	41	34	16	8	<1
Temporary lignum swamp	25460	839	21	10	42	26	<1
Temporary paperbark swamp	4621	566	52	27	18	3	0
Temporary river red gum swamp	71620	3713	22	48	18	10	1
Temporary saline lake	18377	466	28	31	25	11	3
Temporary saline swamp	7683	205	30	14	19	36	1
Temporary salt marsh	6476	212	25	30	33	6	2
Temporary shallow wetland/claypan	73181	7053	53	20	17	9	1
Temporary shrub swamp	26091	1869	58	14	14	14	<1
Temporary Tall Marsh	1671	32	60	36	1	2	<1

Table 46. The percentage of wetland extent for each wetland type in each condition class for the soils sub-index. The extent is the combined extent of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

Wetland type	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Peatlands	4386	2521	46	29	15	10	0
Permanent freshwater lake	30332	397	68	15	12	4	1
Permanent freshwater marsh or meadow	2663	169	43	16	33	6	1
Permanent freshwater swamp	1677	241	83	6	6	5	0
Permanent paperbark swamp	570	41	71	8	1	13	6
Permanent river red gum swamp	6775	131	7	19	52	22	0
Permanent saline lake	22172	177	36	36	12	17	<1
Permanent saline wetland	12089	38	87	9	1	2	0
Permanent salt marsh	3559	59	62	22	0	15	1
Permanent shallow wetland/ claypan	2378	189	66	28	5	1	0
Permanent shrub swamp	963	54	74	16	8	0	1
Permanent tall marsh	458	12	59	0	37	3	0
Temporary black box swamp	234	34	17	2	31	49	0
Temporary freshwater lake	87976	2684	24	21	28	24	3
Temporary freshwater marsh or meadow	52859	5399	28	21	19	26	6
Temporary freshwater swamp	23902	5355	27	27	21	24	1
Temporary lignum swamp	25460	839	16	19	39	25	1
Temporary paperbark swamp	4621	566	32	19	20	23	7
Temporary river red gum swamp	71620	3713	42	27	14	14	3
Temporary saline lake	18377	466	14	34	27	22	3
Temporary saline swamp	7683	205	38	13	36	13	1
Temporary salt marsh	6476	212	39	9	5	44	2
Temporary shallow wetland/ claypan	73181	7053	20	32	26	20	2
Temporary shrub swamp	26091	1869	58	13	10	18	1
Temporary Tall Marsh	1671	32	94	1	5	0	0

Table 47. The percentage of wetland extent for each wetland type in each condition class for the vegetation sub-index. The extent is the combined extent of mapped, inland wetlands that are not classified as dams. "No." is the number of wetlands assessed.

Wetland type	Extent (ha)	No.	Excellent	Good	Moderate	Poor	Very Poor
Peatlands	4386	2521	94	5	1	<1	<1
Permanent freshwater lake	30332	397	60	36	4	<1	0
Permanent freshwater marsh or meadow	2663	169	77	6	6	11	<1
Permanent freshwater swamp	1677	241	84	7	4	5	0
Permanent paperbark swamp	570	41	31	6	61	3	0
Permanent river red gum swamp	6775	131	99	<1	0	0	0
Permanent saline lake	22172	177	77	12	8	3	0
Permanent saline wetland	12089	38	36	2	61	0	0
Permanent salt marsh	3559	59	58	13	24	5	0
Permanent shallow wetland/ claypan	2378	189	59	24	12	4	<1
Permanent shrub swamp	963	54	93	2	4	1	0
Permanent tall marsh	458	12	99	0	0	1	0
Temporary black box swamp	234	34	15	63	13	9	0
Temporary freshwater lake	87976	2684	52	17	15	16	<1
Temporary freshwater marsh or meadow	52859	5399	52	22	16	9	<1
Temporary freshwater swamp	23902	5355	56	26	10	9	<1
Temporary lignum swamp	25460	839	40	29	22	8	<1
Temporary paperbark swamp	4621	566	65	11	14	10	1
Temporary river red gum swamp	71620	3713	77	11	7	5	0
Temporary saline lake	18377	466	62	23	12	3	<1
Temporary saline swamp	7683	205	56	23	17	5	<1
Temporary salt marsh	6476	212	35	24	13	28	<1
Temporary shallow wetland/ claypan	73181	7053	39	30	24	7	<1
Temporary shrub swamp	26091	1869	63	25	8	5	<1
Temporary Tall Marsh	1671	32	76	7	0	18	0

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